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INTERNATIONAL ASSOCIATION FOR DENTAL RESEARCH

Scientific meetings of the Sections in 1927–28

Sectional meetings already held (1927): Boston, November 8; Chicago, November 17; Toronto, November 21; New York, and San Francisco, December 14.

Sectional meetings announced (1928): Chicago, Monday, January 23; West Side Student Y. M. C. A., Wood and Congress Street. Dinner at 6:15 p.m.; meeting immediately thereafter.

All who are interested in dental research are invited to attend the scientific meetings of the sections.

IMPORTANT BOOKS RECEIVED

Textbook of physiology. By WILLIAM D. ZOETHOUT, Ph.D., Professor of Physiology, Chicago College of Dental Surgery, Loyola University. *Second edition.* 1925: pp. 616; 6¾ x 4 in.; 186 illustrations, $4.50. C. V. Mosby Co., St. Louis.

Physiological chemistry; textbook and manual for students. By ALBERT P. MATHEWS, Ph.D., Professor of Biochemistry, University of Cincinnati. *Fourth Edition.* 1925: pp. 1233; 7¼ x 4¾ in.; 109 illustrations; $6.50. William Wood and Co., New York City.

Bacterial infection, with special reference to dental practice. By J. L. T. APPLETON, Jr., B.S., D.D.S., Professor of Microbiology and Bacteriopathology, Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania. 1925: pp. 474; 7¼ x 4 in.; 96 illustrations; $6.00. Lea and Febiger, Philadelphia.

Physical chemistry in biology and medicine. By J. F. MCCLENDON, Ph.D., Professor of Physiologic Chemistry, and GRACE MEDES, Ph.D., Assistant Professor of Physiologic Chemistry, Medical School, University of Minnesota (Minneapolis). 1925: pp. 425; 6¾ x 4 in.; 34 illustrations; $4.50. W. B. Saunders Co., Philadelphia and London.

Dental materia medica and therapeutics, with special reference to the rational application of remedial measures to dental diseases. By HERMANN PRINZ, A.M., D.D.S., M.D., Sc.D., Professor of Materia Medica and Therapeutics, Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania. *Sixth edition.* 1926: pp. 632; 7 x 4½ in.; 146 illustrations; $6.00. C. V. Mosby Co., St. Louis.

Technic of oral radiography. By CLARENCE O. SIMPSON, M.D., D.D.S., F.A.C.D. 1926: pp. 207; 6¾ x 4 inches; 165 illustrations; $5.00. C. V. Mosby Co., St. Louis.

Orthodontics: an historical review of its origin and evolution. *Two volumes.* By BERNHARD WOLF WEINBERGER, D.D.S., Librarian of First District Dental Society of the State of New York, and Advisory Librarian, Dental Department, New York Academy of Medicine, New York City. 1926: pp. 1011; 7¾ x 4¾ in.; 599 illustrations; $25.00 (*two volumes*). C. V. Mosby Co., St. Louis.

American text-book of operative dentistry. By MARCUS L. WARD, D.D.S., D.D.Sc., F.A.C.D., Editor; Professor of Dental Metallurgy and Crown and Bridge Work, and Dean, College of Dental Surgery, University of Michigan. *Sixth edition.* 1926: pp. 818; 7¾ x 4¾ in.; 783 illustrations; $10.00. Lea and Febiger, Philadelphia and New York.

Annuario dental 1926. By SALVADOR DE CASAS (and numerous collaborators). *Fifth edition.* 1926: pp. 462; 6¾ x 4¾ in.; nearly 200 illustrations; 12 Pesetas. Salvador de Casas, Calle de Galileo, No. 5, Madrid, Spain.

A textbook of exodontia—exodontia, oral surgery, and anesthesia. LEO WINTER, D.D.S., Professor of Oral Surgery, College of Dentistry, New York University. 1927: pp. 364; 7¼ x 4¾ in.; 329 illustrations; $7.50. C. V. Mosby Co., St. Louis.

Harelip and cleft palate (cheiloschisis, uranoschisis, and staphyloschisis). By MATTHEW N. FEDERSPIEL, B.Sc., D.D.S., M.D., F.A.C.S., Professor of Oral Surgery, Marquette University. 1927: pp. 200; 6¾ x 4 in.; 156 illustrations; $5.00. C. V. Mosby Co., St. Louis.

A text-book of bacteriology for dental students. By ARTHUR BULLEID, L.R.C.P. (London), M.R.C.S., L.D.S. (England), Assistant Dental Surgeon and Assistant Bacteriologist, Guy's Hospital, London. 1927: pp. 219; 6½ x 4 in.; 60 illustrations; $4.50. C. V. Mosby Co., St. Louis.

Textbook of biological chemistry. By JAMES B. SUMNER, Ph.D., Assistant Professor of Biological Chemistry, Cornell University (Ithaca). 1927: pp. 283; 6¾ x 4 in.; 6 illustrations; $3.50. MacMillan Co., New York City.

The contributions of the Eastern Association of Graduates of the Angle School of Orthodontia to Orthodontics. A review and index of its proceedings. By BERNHARD WOLF WEINBERGER, D.D.S. 1927: pp. 48; 7¼ x 4¾ in.; no illustrations. Eastern Association of Graduates of the Angle School of Orthodontia.

Gangrene of the dental pulp and its treatment, as based on a biochemical investigation. By GUSTAV HEDSTROM (translated by CARL WESTMAN). 1927: pp. 178; 6¾ x 4 in.; 35 figures. Dental-aktiebolaget, Stockholm, Sweden.

Lectures [6] on the biologic aspects of colloid and physiologic chemistry. A series of lectures given at the Mayo Foundation and the Universities of Minnesota, Iowa, Washington (St. Louis), and the Des Moines Academy of Medicine, Iowa. By six investigators in the field. Introduction by LOUIS B. WILSON, M.D., Director of the Mayo Foundation for Medical Education and Research. 1927: pp. 244; 6¼ x 3¾ in.; 85 illustrations; $2.50. W. B. Saunders Company, Philadelphia and London.

American illustrated medical dictionary. By W. A. NEWMAN DORLAND, A.M., M.D., F.A.C.S., member of the Committee on Nomenclature and Classification of Diseases, American Medical Association, and Editor of the "American Pocket Medical Dictionary;" with the collaboration of E. C. L. MILLER, M.D., Professor of Bacteriology and Biochemistry, Medical College of Virginia. *Fourteenth edition.* 1927: pp. 1388; 8¼ x 4¾ in.; 319 illustrations; flexible binding—plain, $7.00; thumb index, $7.50. W. B. Saunders Company, Philadelphia and London.

Dental education in the United States and Canada. By WILLIAM J. GIES, M.S., Ph.D., Sc.D., LL.D., F.A.C.D., Professor of Biological Chemistry, Columbia University; Executive officer of the Board of Editors, *Journal of Dental Research;* with a preface by HENRY S. PRITCHETT, Ph.D., Sc.D., LL.D., Litt.D., President of the Carnegie Foundation for the Advancement of Teaching. 1926 (issued in 1927): pp. xxii + 692; 7¼ x 5 in.; one illustration; distributed free of charge on application, by letter or in person (the volume is "Bulletin No. Nineteen"). Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.

FRANK THORN VAN WOERT

A TRIBUTE TO FRANK THORN VAN WOERT

R. OTTOLENGUI

New York City

Dr. Frank T. Van Woert, one of the most distinguished and best beloved members of the dental profession, died September first, 1927.

Dr. Van Woert suffered a serious illness a year ago, but apparently had recovered, and had returned to his duties at the Dental School of Columbia University. Early in August he had a relapse, from which again he seemed to recover. Then, on the date mentioned, he suddenly informed his wife that he was feeling badly, and asked that his physician be summoned. An hour later he had passed away.

"The evil that men do lives after them;
The good is oft interred with their bones."

It is a strange, and apparently very human fact, that many men receive unusual laudation for some slight achievement, while others may devote hours, and days, and months and years in perfecting methods, or apparatus, which benefit their confreres more than themselves, and yet receive only slight, if any, recognition for their unselfish work.

Such it seems to the writer has been the fate of Frank T. Van Woert. And it is to bring, even thus tardily to the attention of the dental world, a few of his more important contributions to dental progress, that certain facts are here set down.

CONTRIBUTIONS TO DENTAL PROGRESS

Removable facings

Perhaps his invention which has eventually made the greatest impression upon dental practice, was the removable facing. When pins were baked in artificial teeth, and such teeth were backed and soldered to plates and bridges, the porcelain frequently broke away.

This was always exasperating, but in fixed bridgework it was a calamity. Dr. Van Woert devised several ingenious methods of repairing such damaged dentures, and eventually conceived the idea that if the facing were removable and replaceable, and if it could be cemented to the plate rather than soldered, the problem would be practically solved. He invented a method of converting the stock "straight-pin" tooth (as it was then called) into a removable facing. Likewise a most ingenious, three nosed plier for forming the countersunk backing into which a gib on the facing would slide and could be cemented. For these he obtained patents, and they were practically basic patents. These patents were taken, not for profit, but for protection of the dental profession, as by this means Dr. Van Woert prevented the idea from coming into the control of some company who might endeavor to exact licenses for use. The Mason tooth, and later still the Steele facing are evolutions of Dr. Van Woert's basic idea, but he never exerted his patent rights against these manufacturers, because their products were made and sold at a common price to all.

Cataphoresis

Dr. Van Woert was one of the pioneers in the electrolytic application of medicaments, being prominent in all discussions on cataphoresis, for the control of sensitiveness in teeth, when that was the vogue, and later inventing an apparatus for treatment of apical infections by what is best known as "ionization." Dr. Van Woert contended that very light currents could be made effective, and his apparatus carried an amperemeter which calibrated less than a full ampere. He proved his theory because his apparatus was effective.

Radiography

From the first announcement of the discovery of the x-ray, Dr. Van Woert became an experimenter in this field and set his inventive mind to the improvement of methods and apparatus. It is always difficult to prove just who first did anything. But it is safe to say that Dr. Van Woert was among the first, if not the first, to recognize the value of intraoral radiography, and to use films, rather than glass plates. His method was to cut up films into smaller pieces, wrap

these in black paper, and protect them from mouth moisture by again wrapping in unvulcanized rubber. Coincidentally he devised a means of holding the film in position. His method was to use a fairly large mass of impression compound, have the patient close both jaws upon it, and then chill with cold water. When removed from the mouth he had an impression of both sets of teeth, as well as the palatal surfaces of the gums. Into this impression he would place his covered film, and return it to the mouth. When the patient closed the teeth, the impression held the film firmly in place. From this crude yet entirely practical film holder, Dr. Van Woert went ahead with his experiments and inventions, until he finally perfected an x-ray machine, in connection with which his latest film-holder can be used, so that films can be exactly duplicated months apart, a most important factor when attempting to prove the eradication of disease in the alveolar bone.

Porcelain work, inlay methods, etc.

Dr. Van Woert proved his genius in many other lesser ways, but time forbids a complete inventory of these. Suffice it to mention his experiments with porcelain, whereby he perfected a system of fusing porcelain with the minimum of shrinkage. He could make a porcelain crown which would have perfect approximal contact as well as correct occlusion in only two bakings. He was one of the first to experiment with metal inlay methods, and presented the profession with a method of making what he called "cast gold tips" for abraded incisors. Also perfectly modeled occlusal tips of amalgam for molars. Later he gave us a complete system of taking impressions of all types of cavities, for inlay work in general.

Photography

Always an ardent photographer, he experimented with all types, including stereoscopic, and lastly color photography. This latter art he carried to a high stage of perfection and he left in the Columbia School of Dentistry an exceedingly valuable collection of lantern slides, for teaching purposes, all presenting objects in natural colors, and of lifelike appearance.

QUOTATION FROM XI PSI PHI QUARTERLY

Dr. Van Woert was an honorary member of the Xi Psi Phi Fraternity. The following account of his life and activities was prepared by his fellow professor and warm personal friend, Dr. Leuman M. Waugh, and published in the Xi Psi Phi Quarterly, May, 1927, from which it is quoted in part.

"Frank Thorn Van Woert was born in the Town of Half Moon, Saratoga County, New York State, April 16, 1856. His father was John Byron Van Woert, of Holland Dutch extraction, and his mother, Josie E., of English descent, both coming from Saratoga County.

"The family moved to Brooklyn (Greenpoint) when the boy was small and Brooklyn has always been his home. His preliminary education was received in public and private schools, supplemented by a course in Carpenter's Business School.

"He was forced to become self-supporting and at twelve and a half years old left home, acquiring his education solely through his own efforts.

"His intense interest in things mechanical was evidenced when very young, and developed through daily comradeship with his father, who was a skilled mechanic. From his mother he learned the need and pleasure of cultural growth which created the harmonies of existence. The goal which she set for him has furnished a keynote in his desire to attain the best, both in his private life and in his profession, which is so dear to him and for which he has sacrificed much.

"As an apprentice, he worked in the Domestic Sewing Machine Company of Newark, N. J., continuing with the same company as toolmaker and draftsman for several years.

"His first contact with the dental profession was a position with Drs. Stickle and Osmun to study dentistry; he also studied medicine but never registered in medicine.

"His registration was under the law of 1879. First year registration was compulsory and preceded the medical by one year.

"He passed the New York State Board examination in 1890, receiving the Degree of Master of Dental Surgery.

"For six years he served by appointment as Professor of Dental Surgery and Electro-Therapeutics in the University of Buffalo.

"He was made an honorary member of Xi Psi Phi Fraternity (Mu chapter), University of Buffalo, in 1904.

"He served on the Medical Advisory Board No. 18 during the World War.

"Dr. Van Woert retired from the practice of dentistry in 1924 to devote full time to dental education.

"His biography as a dentist evidences his unremitting activities in the field of betterment for his profession.

"The history of the School of Dentistry in Columbia University is intimately connected with any written statement about Dr. Van Woert, covering a period of twelve to fifteen years. He was one of a group of our outstanding dentists, composed of Dr. H. S. Dunning, Dr. L. M. Waugh and Dr. Henry W. Gillett, who interested themselves to bring about the establishment in Columbia University of a school of dentistry of the best and most approved type.

"The School of Dentistry was finally established by resolution of the Trustees, adopted March 5, 1917. In 1917–18 advanced courses in dentistry were offered for practitioners. This together with instruction in oral hygiene was the nucleus on which the present school rose.

"The exigencies of the war period then interfered with the expectations for financial aid and not until 1920 did the name of the School of Dentistry appear in the annual reports. In July, 1923, the existing College of Dental and Oral Surgery was merged with the School of Dentistry of the most approved type.

"Dr. Van Woert's specific work covering this period of the school's history follows:

"Instructor in Root Canal Technic and Radiology in Advanced Courses, 1918–24; also instructor in Radiology in the Courses in Oral Hygiene for Women over the same years.

"He was appointed Professor of Prosthodontia 1916–1919; member of the Administrative Board, 1918–19; Chairman of the Board, 1919–22; Director [1922–27]; Professor of Clinical Dentistry, 1922 [which he held until his death].

"Dr. Van Woert is held in high regard by the officers of the University. To quote from the last annual report of President Butler:

"Dr. Frank T. Van Woert was made Director of the School in recognition of his long and unselfish devotion to its interests and to his years of unrequited toil in trying to serve his chosen profession by bringing into existence in New York a school worthy of its highest ideals.

"The work of the School of Dental and Oral Surgery has been carried on under many embarrassments and difficulties; nevertheless, so substantial are the 'improvements made under Dr. Van Woert's vigorous administration, that the University is now prepared .to deal with the problem of dental education on its merits and in accordance with the highest ideals.'

"Among the active contacts which Dr. Van Woert has maintained outside the educational field in dentistry may be noted the following: Past President of Brooklyn Dental Society; New York Odontological Society; Second District Dental Society; New York State Dental Society; Brooklyn Study Club; also member of the First District Dental Society, National Dental Society, New York Academy of Dentistry; New York Academy of Medicine; honorary member, Kings County Dental Society. Member of the staffs of the following hospitals: Methodist Episcopal Hospital, Brooklyn; Cumberland Street Hospital, Brooklyn; Brooklyn Hospital, Brooklyn; Presbyterian Hospital, New York City; Psychiatric Institute, Ward's Island, New York City.

"In a final analysis, Dr. Van Woert is an idealist; not of the type who dream dreams, but who unconsciously establish the ideal to reach up to not only for himself but for all those who surround him and whose pleasure is to serve him and the cause he so valiantly represents.

"The forces which he combines in a rare measure are the imagery of the artist, the practicality and manual dexterity of the artisan, and the exactness of the scientist.

"Unfortunately, the limitless demands which he had made on his strength and health finally exacted their toll. In June, 1926, he fell ill with a nervous breakdown from which he has been restored but not sufficiently to again take up his trying tasks at the School."

RESOLUTIONS ADOPTED BY THE FACULTY OF THE DENTAL SCHOOL OF COLUMBIA UNIVERSITY

The following resolutions have been adopted by the Faculty of the Dental School:

"Died September 1, 1927, Frank T. Van Woert, M.D.S.

"Professor of Clinical Dentistry, member of the Administrative Board, and formerly Director, of the School of Dental and Oral Surgery of Columbia University

"The Faculty of the School of Dental and Oral Surgery of Columbia University records with deep sorrow the passing from this life of its former leader, Dr. Frank T. Van Woert.

"The story of his life and achievements may well stimulate the ambition of all youthful members of our profession.

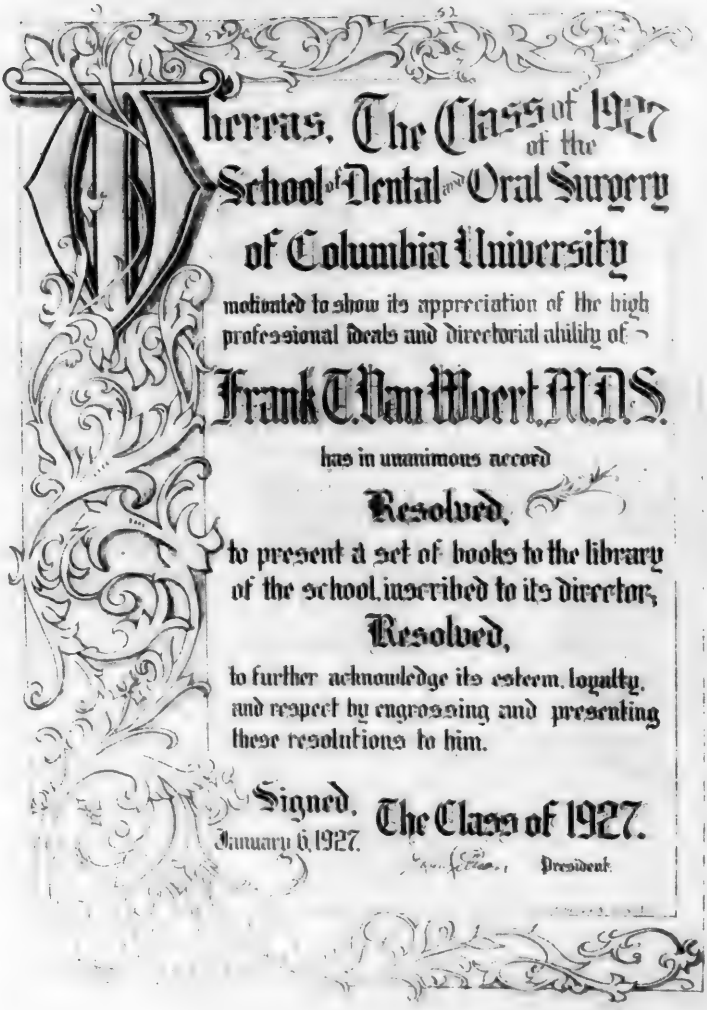
"Winning a professional education over handicaps insurmountable to natures less determined, he progressed to leadership in private practice and as an adviser and clinician among his confreres.

"To many a youth he was a professional father; and to those leaders of the past decades who molded professional thought and practice he was a chosen comrade, to whose counsel respectful hearing was always accorded.

"His sterling personal integrity, his never failing courtesy, his valiant courage and determination in right thinking and fair dealing, and his constant effort to advance the standards of dental practice, made his early selection to the leadership of the Columbia effort in dental education a logical one.

"In this field his notable genius for executive detail found full scope during trying developmental years, and we accord to his memory unsparing praise for effort given without stint and for success of a high order in solving the problems of a transition period in this School.

"We sadly place upon record our deep sense of loss in the death of a dear personal friend, and of an honored leader, who made notable contributions to professional development and progress during more than fifty years of active practice. By unanimous vote of this Faculty, on October 20, 1927, this minute is entered upon our records, transmitted to the members of his family, and published in the leading dental journals."


Whereas, The Class of 1927 of the School of Dental and Oral Surgery of Columbia University motivated to show its appreciation of the high professional ideals and directorial ability of Frank E. Van Woert M.D.S. has in unanimous accord

Resolved,

to present a set of books to the library of the school, inscribed to its director,

Resolved,

to further acknowledge its esteem, loyalty, and respect by engrossing and presenting these resolutions to him.

Signed, The Class of 1927.
January 6, 1927. President.

RESOLUTIONS ADOPTED BY THE CLASS OF 1927, OF THE DENTAL SCHOOL OF COLUMBIA UNIVERSITY, AND PRESENTED TO DR. VAN WOERT IN JANUARY, 1927

PRESENTATION OF A BRONZE PORTRAIT BUST OF DR. FRANK T. VAN WOERT TO COLUMBIA UNIVERSITY BY THE CLASS OF 1927, SCHOOL OF DENTAL AND ORAL SURGERY

On the evening of October 31, members of the Faculty and members of the Class of '27 met for the dedication of a memorial to Dr. Van Woert. The memorial is in the form of a bronze portrait bust. The Class President, Dr. Citron made a few remarks, and then introduced the Chairman of the Class Fund Committee, Dr. Isadore Finkelstein, who spoke as follows:

"Initiated as a tribute to the living, through untimely death the bronze head of Dr. Frank T. Van Woert stands, in the School Library, as a monument for him we so loved and respected.

"Perhaps no one, better than the student, could appreciate the tremendous task Dr. Van Woert accomplished. In retrospect his effort seems almost magical. It is difficult to comprehend the changes wrought during our four years here.

"Just before graduation, the Class Fund Committee prevailed upon the Director to sit for this bust. I say prevailed, for Dr. Van Woert felt that the money would be better spent for some other project, such as research in color photography, or for the School Museum. After much discussion he assented to our request. If ever a man was modest that man was Dr. Van Woert.

"In making this presentation the class of 1927 does not feel that its debt to that generous man is yet paid. We can only repay by being the kind of professional men and women he sought to make us.

"In the arch, at the entrance to Grand Central Terminal, is inscribed this legend: 'To all those who with head, heart and hand toiled in the construction of this monument to public service, this is inscribed.'

"In like manner did Dr. Van Woert labor for us.

"Dr. Owre, Dr. Van Woert's friend and colleague for many years, told me that Dr. Van Woert felt that the student's appreciation of his efforts was the crowning reward of his work. We can find consolation in the thought that, in thus showing our appreciation, we did something that brightened his last few weeks among us.

"Dr. Owre, the class of 1927 presents to you, as Director of the School of Dental and Oral Surgery and representative of the University, this head and pedestal to stand as a permanent testimonial of our regard for your predecessor Dr. Frank T. Van Woert.

"I hope you will not think I am presumptuous in saying that we feel that the building of the structure, the foundation of which Dr. Van Woert so solidly set, could not have been left in more capable hands. We expect great things under your régime; we know we shall not be disappointed."

The following response was made by the Dean, Dr. Alfred Owre:

"It gives us all a sense of spiritual joy to know about this act of the student body. It was sweet of you to show your appreciation of Dr. Van Woert in this way. He sensed keenly your sincerity and friendship; it was a genuine comfort to him to know this before he passed away. By your thoughtful consideration you did much for him and much for the School of Dental and Oral Surgery of Columbia University. You have immortalized him as well as an ideal.

"It was Dr. Van Woert's deep conviction that if dentistry was to have a future it must be secured through the university; he fought for this and refused many tempting proposals in private educational ventures. It was an uphill battle, but he had faith in this ideal and was willing to make the sacrifices its attainment demanded.

"It is good to know that you have friends and sturdy ones too. In this sense he often referred to the student body and the Class of 1927. 'I have them with me and that is everything,' was a remark he often made to me during the summer. 'They (the students) want to make this a real university dental school.'

"Our friend has left us in the physical sense only. Together we can go on striving for higher and better things. This occasion calls attention to that, in the very quiet way in which Dr. Van Woert would like to have it done I am sure. It is a moment for communion of thought with one whose spirit is still with us. We all want to participate in these simple exercises. This afternoon the thought of our departed Director brings into relief our common purpose. We all appreciate the beautiful spirit and motive of the Class of 1927, and with the deepest gratitude we, the faculty, accept your expression of love."

In conclusion, the writer is grateful for the opportunity, sad as it renders him, to register his inestimable debt to Dr. Frank Van Woert, whose unremitting friendship over a period approximating forty years created for him one of the greatest satisfactions of his professional life.

A SYMPOSIUM ON THE MANAGEMENT OF A DENTAL PRACTICE[1]

WILLIAM D. TRACY, D.D.S., F.A.C.D., HUGH D. COMBS, ESQ., AND JUDGE MOSES GROSSMAN

New York City

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I. THE RECEPTION AND MANAGEMENT OF NEW PATIENTS IN DENTAL PRACTICE

William Dwight Tracy, D.D.S., F.A.C.D.

The subject assigned to me is one which I feel is of vital interest to all of us. I have known instances of disharmony, misunderstanding, and dissatisfaction on the part of patients which might "easily" have been prevented or avoided by proper management on the part of the dentist in his contact with the patient. Such experiences as these are extremely disturbing to any conscientious practitioner, and in some cases may be detrimental to his professional standing; for it is quite true that a displeased or disgruntled patient is always more inclined to discuss his dental experiences than is the person who has had dental work completed to his entire satisfaction. Of course the fundamental and controlling factor in the relations that a real professional man has with his patients is his own conscience. The serious minded worker, who knows in his own heart that his patients' regard for him must ultimately be based upon honest effort in every detail of his treatment and procedure, enjoys a certain security, which, in the case of the man who takes his work casually, may be lacking.

[1] Papers read at a meeting of the First District Dental Society of the State of New York, New York Academy of Medicine, March 1, 1926.

No sane man boasts one hundred per cent success in his dental work, nor can he expect the same degree of success in the management of all his patients. There are certain types of individuals whose personality, temperament, and mentality are such that even in the hands of a dentist of wide experience, mature judgment, and excellent self control, disharmony may creep into the relations existing between them before the work is completed. We expect to meet and successfully cope with all kinds of peculiarities, whims, and notions in our patients, but perhaps our most trying experiences are the occasional encounters with the apparently well bred and intelligent persons who turn out to be entirely unreasonable. When dentist and patient reach an impasse in a fruitless effort to understand each other, it would be better for both to discontinue relations. Fortunately such incidents are rare in a well regulated practice, but they may occur. One of the pleasant things about the conduct of what may today be termed an old-fashioned family practice is the feeling of friendliness and complete understanding and confidence that are extended to the dentist by a large portion of his practice. New patients who may come into one's practice must be taken care of, however, and I am asked to discuss ways and means of providing for this increment with the greatest satisfaction and least trouble to all concerned.

In a general practice in any large city it is safe to say that the three most constant sources from which new patients come are first, the satisfied patients already in the practice; second, dentists in other towns, cities, or countries who are glad to refer cases to the dentist in whom they feel confidence, and whom they may know personally or by reputation; and third, physicians and other dentists who may send patients for diagnosis, opinion, and advice.

In receiving new patients who come to us on the recommendation of other patients, it is usually not difficult to establish pleasant and satisfactory relations if the dentist and patient understand each other at the outset. In my own practice, on meeting new patients in this class, I hear their story, frequently minister temporarily to their discomforts, and suggest an appointment with one of my associates for prophylaxis and examination. If the patient is one who desires to come under my personal care, a chart is submitted to me, together with complete x-ray survey and plaster models where needed, as the

diagnosis is the first important step in the case; appointments are made and, at the first sitting, time is taken to discuss the nature of the work required, and the probable amount of time needed; and toward the end of the talk the suggestion is offered that, if they are interested to have an approximate idea of the cost of the proposed work, it will be gladly submitted. Where the amount of work needed is small and the necessary sittings are few in number, the patients frequently ask me to proceed and render my bill for the services when completed. This is what may be termed the simplified procedure and usually works out satisfactorily in the end.

Where a patient has been negligent of the teeth for any one of the many reasons with which we are more or less familiar, and we find work of an earlier date that must be removed and done over to safeguard the future welfare and integrity of the teeth, the conditions become a little more complicated and a detailed statement of the situation is necessary. In such a case it is wise after a careful examination, with a complete x-ray survey and study models in hand, to explain to the patient in simple language just what conditions prevail and what steps may be necessary to restore the denture to normal efficiency or at least as near to normal as possible. All this can usually be made quite clear to the patient by the use of the hand mirror, the x-ray films, and plaster models. This conversation very frequently brings forth an inquiry as to how long the work will take and what the probable expense will be. I have found it desirable in most cases of extensive restoration to say to the patient that I would have to give the matter more study and that I would write to him giving details. This method gives the dentist an opportunity to make an approximate estimate in writing, of which a carbon copy is placed on file for later reference if necessary.

Some of our new patients show that they have always had a high type of dental service before coming to our offices, and with such patients there is usually no trouble concerning fees. Occasionally, however, a patient in this class may have had a competent operator in a small town or city, and been accustomed to fees much lower than those charged in the larger cities. If a question arises on this score, it is easily answered; and, if the patient decides that the work planned is beyond his or her means, it is better to have an understanding before

than a misunderstanding after the work has been done. When we find in the mouth of a new patient work of an inferior quality, which has apparently been executed with lack of skill and with poor judgment, the situation becomes delicate, and must therefore be handled with tact and discretion. With perhaps very rare exceptions these cases can be negotiated without casting reflections upon the previous dentist or his work. There are many ways of explaining why the work must be removed and replaced without belittling or disparaging the man who inserted it.

My observation leads me to believe that many dentists do not realize how far reaching and how damaging a defamatory remark concerning another practitioner may be. For them it seems all too easy to criticise, to ridicule, and to condemn. I would urge such carping critics to remember that no worker however skillful in the field of dentistry is one-hundred per cent perfect, and that even the most competent operator may make errors in judgment and have failures in his handicraft. Would such a carping individual himself like to be condemned in wholesale fashion upon the evidence of one of his cases that had failed? I rather think not. I am not taking the attitude that we should commend or even defend crude and incompetent work, but I do feel that our conversation with patients should be of such a nature that, wherever humanly possible, they shall not discredit or bring into disrepute their former dentists. No doubt you are mentally asking how this can be done, and I will reply that a competent answer cannot be given in this short paper. To answer briefly, however, the statement may be made that the legitimate use of tact will go a long way toward meeting the requirements of most situations.

In a paper which I read in December, 1922, I defined tact as follows: "Tact may be described as that personal quality which enables the individual through an alert mental discernment, or through intuitive appreciation, to realize what is fit and proper to do or say in any given situation. Tact in those who possess it, enables the individual to avoid saying or doing things that would offend or disturb another, and is based largely upon a sensitiveness to the feelings and an insight into the motives of others." A remark which might arouse in the mind of the patient a suspicion of doubt concerning the former dentist must be classed as a tactless act, and must be regarded as an unkind-

ness to the patient himself as well as to the former dentist. Furthermore, loose comment made by one dentist concerning another, or adverse criticism in regard to the work of another, if occurring frequently, would result in injuring the standing of the profession in the public mind; and on this basis such activities on the part of the professional man are to be deplored.

One of the most perplexing situations we have to meet is that connected with patients who come to us on the recommendation of friends, stating that they have decided to make a change of dentists, and we find that the change has been made because the patients are dissatisfied with elaborate and expensive dental restorations. The conversation quickly discloses the fact that the patient is not only displeased, but that he is disaffected and is mentally irritated by a real or frequently an imagined grievance against his former dentist. In many instances such patients may be placated by explaining certain conditions with which they may not be familiar, and sometimes some adjustment or small change in the work may be effected that will improve the mental attitude. On the other hand, an occasional patient seems determined by the asking of leading questions to elicit a statement or comment that will directly or indirectly amount to a condemnation of the judgment or the handicraft of the previous dentist. With leech-like tenacity, and with a spirit of venom that is unmistakable, the patient may persist, thus taxing one's mental resources to meet the questions and give replies couched in a manner that will not involve the former dentist, and still will not disregard the truth. As a matter of routine it is wise to urge such patients to return to the dentist who did the work, and give him an opportunity to make some change in it or to do it over if necessary, assuring her that he will no doubt be glad to have the opportunity. This suggestion is usually rejected, but if the battle of words continues and gives evidence of developing into an unpleasant situation, I would say to the patient that I fear that I would be unable to give him satisfaction and recommend that advice be sought elsewhere. This, of course, is an extreme case, but it is mentioned to bring out the point that I personally would rather lose a case regardless of its importance than to become entangled in an unpleasant situation that might involve a law suit.

Frequently we are called upon to treat patients who may be sojourning for some months in our city, but who have not severed their relations with the home dentist. In instances of this sort our main idea should be to administer such treatment as may be necessary to keep the patients safe and comfortable until such time as they may again place themselves under the care of their own dentists. This can frequently be accomplished by the use of cement or guttapercha according to the location of the cavity. If a year or more is going to elapse, however, before relations with the home dentist are to be reestablished, and we feel that some type of permanent work is necessary to assure the safety of the tooth and proper protection of the interdental space, the situation should be carefully explained to the patient so that he will understand the reason for recommending permanent work.

After suggesting the use of a temporary expedient, patients frequently inquire whether the work cannot be done with a view to gaining a more permanent result and express a desire to have the tooth under consideration fixed with something more stable than cement or guttapercha. Under these circumstances we are justified in meeting the patient's request, but I consider it bad policy to recommend extensive work in the mouths of transient patients if it can be avoided, and it usually can be. I think it is impolitic, also, to place an extensive gold inlay in the mouth of a patient of this class who has never had anything but amalgam posterior to the first bicuspids, unless an understanding has been reached between patient and dentist in advance. Otherwise the patient might resent the perfectly fair fee charged for the work, and the home dentist might feel that the city dentist had taken advantage of his patient. Almost all such disagreeable incidents can be avoided by the use of good judgment and forethought.

When a physician sends a patient to our office we may have advance information from the doctor by telephone or letter explaining all the conditions that prevail, including the statement that the patient has implicit confidence in his dentist, but the physician himself requests a thorough examination for the purpose of gaining a second opinion concerning some point of doubt. This is a clear cut proposition, and when the examination and diagnosis is completed, a typewritten

report of the findings, together with recommendations for treatment, are submitted to the physician. In cases of this type both physician and patient may request you to take the case, and to clear up the trouble that gave rise to the consultation. Under these circumstances I take the position that the family dentist be advised that the patient desires to have certain work done elsewhere, and that she is not leaving his practice permanently but will return to him later. This can usually be arranged by the physician and patient, after which the work is done. Patients who come in casually, saying that they were advised by their physician to consult us for examination and treatment, are taken without question on the assumption that they have no dentist or that they desire to make a change. Now and then physicians send us patients in whom we find that, although the dental work in the mouth has been done with care and skill, an individual piece of work has failed, causing the patient some annoyance and discomfort. Under these circumstances I invariably advise the patient to return to his own dentist whose work shows that he is a skillful and competent man. The patient may urge us to administer the necessary treatment, but this should be refused. The patient may leave the office in an unpleasant frame of mind, but I feel that I have dealt with the case as I would wish a brother dentist to deal with a patient of mine should a similar circumstance arise.

Patients coming to us from other dentists usually are referred when there is difficulty in making a definite diagnosis, or when some special type of work is required. In the former instance, after a complete and careful study of the case, the patient is naturally referred back to his own dentist with all the information that has been gleaned, and with such advice and counsel as it may seem fitting to offer. In the case of the patient who comes to have some special type of work done, it is our duty, when that is completed, to refer the case back to the patient's own dentist. If the patient requests that other work be done, it is necessary to explain that definite arrangements had been made for certain work only, and that for the other operations needed the patient must return to his own dentist. From my own point of view consultations are desirable where doubt exists in an important case, and not infrequently I suggest to patients that a second opinion may be desirable. Sometimes the very suggestion of a consultation seems to

bring about a change in the mental attitude of a patient who may be perplexed and worried about his dental situation, and he will say: "Well doctor, I am perfectly satisfied to accept your judgment in the matter and have you proceed with the work." In other instances the patient will ask to whom he should go for a second opinion, and I am always glad to mention the name of one of my confreres whose judgment I hold in high regard. Consultation with the physicians who are in charge of our patients are frequently called for, and should be entered with a spirit of frank open-mindedness and generous co-operation, thus helping to establish that confidence and cordiality that should exist between medical men and dentists.

In establishing relations with new patients who are in serious dental trouble, it is well to maintain a spirit of optimism, while at the same time acknowledging the gravity of the situation. This is always cheering and helpful to both patient and operator. But beware of making extravagant promises about what is to be accomplished. We may help and encourage our patients in many ways, during the most disagreeable and disturbing period of our work, without committing ourselves too definitely to the attainment of an ideal result. We should have fixed in our minds, however, the picture of a result as near to perfection as it may be possible to achieve; and when the work is completed, and the patient is again comfortable and presentable, his satisfaction will be even greater than if we had made lavish promises in the beginning. And we will experience the comforting satisfaction that comes from the knowledge that our professional services have been well rendered.

Let us always remember that the welfare of our patients is paramount, and that what is best for them is in the end best for us. Let us not forget, also that a good reputation, as Mr. Otto Kahn has so well said, is something of our own making—that it cannot be purchased with money and that it cannot be inherited. While kept intact it works favorably for us, but unless well guarded may slip away from us overnight. Anything that tends to tear down or discredit the ethical standing of dentistry as a profession is to be deplored. Sensible ethical relations are helpful in maintaining the regard that the public will have for the profession.

II. SAFEGUARDING THE DENTIST'S INTERESTS FROM THE LEGAL STANDPOINT

Hugh D. Combs, Esq.

The malpractice situation, as it exists today, is far different from the standpoint of lawyers for the defendant dentist than it has been in past years. I want to bring to your attention particularly the fact that it is becoming somewhat less difficult for the plaintiffs in action to secure so-called expert testimony by dentists to be used against a brother dentist. I will not say that this has developed into a tendency, but it is something to think over, and to consider in the light of professional ethics. No lawyer, or insurance company, or society, wishes a dentist to perjure himself or say anything on the witness stand that is not true. But recently we have found that there are dentists willing to answer what we lawyers call "hypothetical" questions in a manner not in the best interest of the defendant in the case.

In the insurance company with which I happen to be connected, there are over 1500 claims of malpractice against dentists in this city in the course of a year. About 225, on the average, go to suit. A similar proportion, varying each year, are finally taken to trial. None are settled, except those which have been taken up with the committee of your society. A large proportion of the cases are dropped, but a few of them result in verdicts for the plaintiff. These verdicts range from $500 in the municipal courts to $12,000 or $15,000 in the Supreme Court. Fortunately, so far, there have been comparatively few in the last-named court. The cases that produce verdicts for the defendant are those, of course, in which the dentist is right. That class of cases includes so-called infections, broken needles, and broken teeth. Cases that bring verdicts for the plaintiff are cases involving the extraction of the wrong tooth, or extraction by a "strong arm method," bringing away a part of the alveolar process with the tooth. In broken needle cases, the dentist sometimes considers he has a secret to hide, or something to be ashamed of. Sometimes we have cases where a tooth is dropped down the patient's throat.

The cases that result in verdicts for the defendant—broken needle cases—are those in which the dentist tells the plaintiff immediately that the needle has broken. There is no liability on the part of the

dentist because an instrument breaks. Such an accident may happen to anyone. No one can tell just exactly what metal is contained in the fine steel needle, and the courts recognize that an accident of this kind is apt to occur. But the danger lies in the failure of the dentist to immediately advise the patient of the accident, and take proper precautions to help the patient, and have the needle or the broken part of it removed.

The infection cases are generally such as involve other diseases than those of dentistry—cases, perhaps, of blood diseases. The plaintiff in the case has a real or fancied grievance, which I will touch on later, and develops an infection in another part of the body, and a suit for malpractice results.

The broken-teeth cases may be classed in the same category as the extraction cases. They generally result in verdicts for the defendant. In cases where parts of roots are left in the jaw, and are subsequently extracted by experts—the dentist having advised the patient that a tooth has broken, or some part of it is not there—a verdict can generally be obtained for the defendant.

A case where the dentist extracts the wrong tooth is a little more difficult proposition. From the standpoint of the defendant's lawyer, there are generally explanations which can be made for the extraction of the tooth. There is no liability against the defendant for a mistake in judgment. If, in his judgment, the tooth should be removed from the mouth, and he removes it, and a suit is brought, he need only justify his course by his experience, and the statement that in his opinion it was necessary to remove that tooth, giving the reasons therefor.

There are cases, however, where the wrong tooth is removed when it was the intention of the dentist to extract a different tooth. In this class of cases, it is absolutely fatal to attempt to put back the tooth after you have taken it out! Strange as this may seem, an interesting case, with which perhaps some of you are familiar, was tried in the New York Supreme Court about a year ago, in which a $6,000 verdict was recovered against the dentist for the extraction of the wrong teeth, and in which an attempt was made to replace the teeth improperly extracted. Of course such an action is a clear admission of mistake,

and the substantial judgment rendered against this dentist was fully justified.

The law requires you to have ordinary skill and learning such as is possessed by other dentists in the locality in which you practice. You do not guarantee a good result. This means that your judgment is all that is required, and the result is problematical. If your judgment is good, you get the credit, but if it is poor, you should not get the blame. I have always considered that dentists were laboring under a handicap. In the medical profession, a doctor makes a mistake, and he has the undertaker bury it. If the lawyer makes a mistake, he tells the client the court went wrong, advises an appeal, and gets a larger fee; but if the poor dentist makes an alleged mistake, he is sued for $50,000.

What are the ways of preventing suits for malpractice? One of them is to require—I say this as a lawyer (as Dickens would say, "as shouldn't!")—that the plaintiffs file a bond for costs when they bring an action in your Supreme Court. This would go a long way towards eliminating the enormous volume of litigation we now have, and would cut down the number of unwarranted suits which are brought not only against you as dentists, but against landlords and other persons with any capital. Secondly, as an insurance man, I cannot pass over the advantage, so far as your pocketbook is concerned, of carrying insurance. Thirdly, proceed slowly and methodically, and convince the patient that you are giving exclusive attention to him—that your sole interest at the time is the welfare of the patient. Do not tell the assistant to "order two tickets for the ninth row for the 'Follies' for tonight," and at the same time revolve the disk or bur in the patient's mouth. Do not go to the telephone two or three times to talk to your broker about the stock market. Do not do second mortgage business while you are making $5 in extracting the patient's tooth. The patient remembers this. While at the time the matter may appear trivial to you and to the patient, the idea remains in the patient's head that you did neglect her, and had something else in your mind; and this sort of testimony is very harmful to you when it is rehearsed on the witness stand.

If anything happens, tell the patient. If you get into a difficulty,

or an emergency arises, do not be ashamed to call in someone whom you think knows more about it than you do. They may not know more, but you can convince the patient that you got a better man to confer with you, and that you are doing everything in your power.

Keep adequate and careful records in your office. Nothing hurts your case more, or lessens the confidence of your lawyer, than to say: "Let me see—on the Fourth of July I went on my vacation, and then I went down to Gettysburg—I think this must have been about the middle of May." Sometimes claim is made against you although a diseased condition pre-existed on the date of your treatment, and we are at a loss in defending your case because of inadequate information. Know what you did to the patient, and when.

Keep your office clean. That is not necessary to say in 99 cases out of 100; but somewhere in this room there is one fellow who does not keep his office clean. I will not say who it is, but he guesses; and your lawyer has a terrible time trying to show how cleanly you kept your office, and the whole neighborhood perhaps has a different opinion!

Do not shell-shock a man by sending him a bill for $400 when he thinks it is to be about $27. Tell him how much the bill will be, and how long the job will string out, and then you will not have to hire some of the collection agencies that produce the malpractice cases. When you send out your bill for collection, and the patient thinks it is too much, he does not pay it. You place it in the hands of the collection agency or your attorney, who tries to collect it without suit. Finally he has to commence suit. As soon as the patient gets the papers, he goes to his lawyer, and the lawyer says: "There is only one defense, and that is malpractice." After you have waited around the court a while, you get disgusted, and want to quit, and sometimes the patient wants damages. You have done all the work and there is nothing the matter with your work. But like a snowball revolving, your troubles continue to grow as far as you are concerned; and, instead of feeling you ought to get about half the money you asked for, the patient decides that you should give *him* about twice as much.

Usually there is one important proposition involved in malpractice lawsuits, and that is the question of fact. The entire case is submitted to a jury. You tell your side of the case, and the patient tells his,

and they are about as far apart as the North pole from the South pole. When you hear the plaintiff tell what you did to him in your office, you will not know yourself. Then too, the judge does not know you, nor, for that matter, does he know the plaintiff. The judge says to the jury: "I have nothing to do with the facts of the case—all I have to do with is the law. You decide the facts." All that means is: "whom do you like best, the plaintiff or the defendant? Whom will you believe? Who looked best on the witness stand?"

And that is where your personal appearance comes in. If you come to court, and do not look like a pretty good dentist, the jury may decide the case from the way you look. If you talk too much or too little, the jury will often decide your case on that basis. You can see what chance you have of being considered a good dentist, if you do not look the part when you come to court.

Finally then, use your best judgment, give the patient the best that is in you, use ordinary sound business sense in the conduct of your office, have regard for your own personal appearance, and you need not fear the result of malpractice lawsuits.

III. LEGAL ASPECTS OF DENTISTRY

Judge Moses H. Grossman, Honorary President, American Arbitration Association

For some time I have been very deeply interested in the legal aspects of dentistry and the work of professional men as a class—dentists, doctors, lawyers, and ministers. They all subject themselves to hazards because of personal contacts with their patients, clients, and parishioners, and because of the fact that a trial in a court of law is public.

The Constitution provides that a trial is open to the public. Therefore, a patient seeking to take advantage of his dentist or doctor, or a client seeking to take advantage of his lawyer, has only to make a charge of malpractice in order to scare the professional man. It is easy to start an action. It takes a lawyer only thirty seconds to draw a summons, and the process server then leaves the lawyer's Wall Street office for Harlem, or other destination, and the suit may be for $100,000 for malpractice, assault, libel, or slander. No matter

how innocent the professional man may be—no matter what the claim is—the law permits that facility of action. The professional man is then put to the necessity of employing a lawyer and spending a large amount of time in protecting himself against this onslaught, to say nothing of being subjected to publicity and notoriety meanwhile. The best we can hope for is a verdict for the defense.

And yet, under existing law, it is impossible for anyone to sue a dentist or any other professional man, if he will but take advantage of the facilities the law provides for him. Not only that, but any disputes which do arise can be settled within a week or two by a trial under the law, but not a public trial. No one can be admitted to this trial unless both parties consent; otherwise the door is locked. The judges who preside at that trial will be leaders in the profession in which the dispute occurs. How can all this be done, you ask. I am going to tell you.

For a thousand years the professions of the bench and bar have battled with an apparently unsolved problem—the problem of delays and costs. Herbert Hoover says: "Next to war, the greatest single item of preventable waste in civilization is litigation." When we eliminate this great item of preventable waste in commerce and industry we will give the prosperity of the nation a great boost. The average professional man, afraid of publicity, knowing the expense of having counsel, and the time it will cost him and his friends who are experts, and the possibility of an adverse verdict, is often willing to submit to extortion and blackmail because the odds are against him. That is going to be overcome by the plan I mentioned above, a practical, simple, concrete plan, which every dentist in this city can adopt—a highly ethical plan, which your counsel and associations will approve.

Under a law passed in New York State in 1920, any two men having a dispute which could be carried into a court of law, are now permitted by a simple little instrument in writing to say: "We agree to leave the decision of this question to Dr. Blank, Mr. John, or Dr. Doe, or to all three." When these three take an oath to decide that question justly, something happens under the law. The law says to these men: "You now have substantially the same power to decide this

case as if you sat on the Supreme Court Bench. You can subpoena witnesses and bring them into your private court. You can bring in books and papers and hear the testimony—not like a judge does, with objections, but in a commonsense way, and you are not bound by rules, as a judge is—and you can render a verdict; and when you do, it becomes a verdict of the Supreme Court." That is pretty good, is it not?

What is this method called, and what law places this simple and businesslike way of settling disputes at our disposal, you ask? The answer is that this method of settling disputes is called "arbitration," and is provided for by the Arbitration Law of the State of New York, which was passed in 1920. Since then the Federal Government and five other states have passed similar laws. This arbitration law, which permits any dispute to be submitted to arbitration, also provides that when any contract is made for services by a doctor or a dentist, or for merchandise, in case of a future dispute, it shall be arbitrated under the New York law, and that the parties being bound by the covenant cannot sue one another in a court of law. They must go to arbitration, and if one refuses, the other may apply to the court for an order to compel him. The court says: "Did you sign this arbitration clause?" "Yes." "Then name your arbitrator or we shall name one for you."

Now you may say, "that is very good where you have a contract for merchandise—it is a written contract—but we are dentists, and we cannot have a written contract where we are delivering service and not merchandise. If you say to a patient: 'Sign this contract,' he may become suspicious and say: 'Are we going to have a dispute?'" The answer to this is that most dentists have assistants who take the name and address of a patient and type them on a "history card." An arbitration clause can be printed on the card, above the name and address, and the patient asked to sign instead of the assistant typing it, the signature being optional with the patient. If he does not understand the clause, or why printed on the card, you can point to a resolution which I am going to suggest you adopt and have copies placed on your office wall, or in your files, and explain to your patient the reason why it is mutually advantageous.

The resolution should be like one recently adopted, which reads as follows:

Be it resolved—[2]

First: That it shall be deemed to be more professional and dignified for members of the Association of Graduates of the Angle School of Orthodontia to submit such disputes to arbitration rather than to enter into a public court trial over such disputes.

Second: That each member of said Society be urged to make every effort to agree with his patients to submit such disputes to arbitration, under the arbitration rules of the American Arbitration Association.

Third: That each member of said Society take such action as he may deem advisable to bring to the attention of his patients his belief in and adherence to the principle of arbitration; and

Fourth: That it is recommended that each member of said Society insert in all of his written contracts, or in his letters confirming business understanding reached with his patients, the following arbitration clause or one of similar intent: "In the interest of the retention of a friendly professional relationship, it is agreed that any dispute or claim arising out of or in connection with the dental services referred to herein, shall be settled by arbitration under the rules of the American Arbitration Association."

[2] This resolution has been adopted by the First and Second District Dental Societies of the State of New York, since Judge Grossman made the speech from which this article has been prepared. Further information on this subject can be obtained by addressing the American Arbitration Association, 342 Madison Avenue, New York City.—[*Ed.*]

ANALYSIS OF DENTAL GOLD ALLOYS*

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ABSTRACT

Complete chemical analyses of about 40 dental gold alloys were made as part of the investigation of their physical properties. These analyses required the determination of silver, gold, platinum, palladium, iridium, rhodium, copper, zinc, nickel, tin, manganese, iron, and magnesium. Methods as found in the literature for the determination of the above-named metals were modified so as to give accurate results when applied to alloys of this type. New methods were developed for the determination of tin and iridium. Many analyses of mixtures of known composition are given to show the degree of accuracy of the methods used. These methods are assembled in a detailed procedure for the complete analysis of dental gold alloys. The composition of 13 typical alloys is given in a table (page 409).

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* Scientific Papers of the Bureau of Standards, No. 532. Reprinted from Vol. 21, 1926. The methods of analysis described in this paper are now in routine use at the Bureau of Standards.—[*Ed.*]

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I. INTRODUCTION

The study of the properties of dental gold alloys has been an important part of the general research on dental materials begun several years ago at the Bureau of Standards in coöperation with the Weinstein Research Laboratories.[1] In conducting this work on the alloys it became necessary to determine their chemical compositions. About 40 alloys were analyzed by the author while employed by the Weinstein Research Laboratories as a research associate. The purpose of this paper is to describe the methods used and to assemble them in a complete procedure for the analysis of materials of this kind.

Dental gold alloys are, in general, composed chiefly of gold, silver, copper, and platinum. The proportionate amounts of these metals are usually of the order of 60 per cent of gold, 10 to 15 per cent of silver, 10 to 15 per cent of copper, and 10 per cent of platinum. Palladium is often substituted for part or all of the platinum. Many alloys contain small amounts of iridium and occasionally one is found to contain rhodium. Of the base metals besides copper, small amounts of nickel, manganese, zinc, and tin are found in many of the alloys and occasionally iron and magnesium occur. As many as nine of the above-named metals have been found in a single alloy. A number of these were undoubtedly present as impurities in the major constituents.

No procedure for the complete analysis of such alloys is given in the literature. Many of the methods given for the determination of the noble metals proved to be inaccurate when applied to these alloys and

[1] Dental research, *J. Am. Dental Assn.*, 11, p. 249; 1924. Physical properties of dental materials (wrought gold alloys), by R. L. Coleman, Jr., *J. Am. Dental Assn.*, 12, p. 520; 1925.

had to be modified. A new method was used for the determination of iridium. For the determination of the base metals it was found possible to adapt methods that are in general use, except that a new method was devised for the determination of tin.

In connection with the study of the physical properties of dental gold alloys, it was desirable to determine their composition with the highest possible accuracy. This procedure was, therefore, developed with that end in view. Many of the details of the procedure can be omitted when the accurate determination of all the constituents of the alloy is not required, as, for example, in control analyses. The various steps of the procedure are discussed in the order in which they would generally be carried out in making a complete analysis.

II. SAMPLING

The alloys submitted for analysis are usually in the form of wires, bands, or plates. These should be rolled out on a pair of hand rolls to a ribbon or sheet 0.003 to 0.005 inch thick. These rolled pieces are then clipped to short lengths or small squares one-sixteenth to one-eighth of an inch in size. Uniform and representative samples may then be obtained by selecting at random a suitable number of these small pieces.

It is often advisable to make a qualitative examination of the sample before proceeding with the quantitative determinations. A sample of about 1 g is usually sufficient for this. For the quantitative analysis a weight of sample should be chosen that will contain enough of the minor constituents for their determination with sufficient precision and still not contain inconveniently large amounts of the major constituents. For most alloys 2 g is a convenient weight of sample.

III. REAGENTS

The following reagents are used at the concentrations described below, unless otherwise stated in the text:

Sulphuric acid (sp. gr. 1.84).

Nitric acid (sp. gr. 1.42).

Hydrochloric acid (sp. gr. 1.18).

Dilute sulphuric acid.—1 volume of sulphuric acid, 1 volume of water.

Dilute nitric acid.—1 volume of nitric acid, 1 volume of water.

Dilute hydrochloric acid.—1 volume of hydrochloric acid, 1 volume of water.

One per cent sulphuric acid.—1 cc of sulphuric acid, 99 cc of water.

One per cent nitric acid.—1 cc of nitric acid, 99 cc of water.

One per cent hydrochloric acid.—1 cc of hydrochloric acid, 99 cc of water.

Aqua regia.—4 volumes of hydrochloric acid, 1 volume of nitric acid, 1 volume of water.

Dilute aqua regia.—4 volumes of hydrochloric acid, 1 volume of nitric acid, 6 volumes of water.

Ammonium hydroxide (sp. gr. 0.90).

Dilute ammonium hydroxide.—1 volume of ammonium hydroxide, 1 volume of water.

Strong sodium hydroxide solution.—50 g of sodium hydroxide sticks, 100 cc of water.

Dimethylglyoxime solution.—1 g of dimethylglyoxime, 100 cc of 95 per cent ethyl alcohol.

Ammonium thiocyanate, 4 per cent solution.—4 g of ammonium thiocyanate, 100 cc of saturated solution of sulphur dioxide in water.

Sodium acetate solution (used for the precipitation of tin).—This solution is prepared by adding 300 g of sodium bicarbonate to about 205 cc of glacial acetic acid and diluting the solution to 900 cc. The final solution should give an acid reaction with methyl red. Three cc of this solution contains 1 g of sodium acetate.

Ammonium acetate solution (used for the precipitation of tin).—This solution is prepared by nearly neutralizing 250 cc. of glacial acetic acid with ammonium hydroxide and diluting the solution to 1,000 cc. The final solution should give an acid reaction with methyl red. Three cc of this solution will contain approximately 1 g of ammonium acetate.

Many of the precipitates obtained in these analyses are finely divided and have a tendency to pass through even the tightest filter papers. Such precipitates can be held on the paper if it is first treated with a suspension of finely divided filter-paper pulp. This

may be prepared by digesting several 15 cm pieces of ashless filter paper with 300 to 400 cc of distilled water in an Erlenmeyer flask and then shaking vigorously until the paper is disintegrated. Enough of this suspension is poured on the filter after it is fitted in the funnel to fill the paper to the rim. After the water has drained off the filter is ready to use.

IV. QUALITATIVE EXAMINATION

A careful qualitative examination of the sample is necessary for the detection of the minor constituents. The presence of the major constituents usually becomes evident during the search for the minor constituents. Only those metals which were mentioned before as having been found in dental gold alloys will be considered here, namely, gold, silver, platinum, and copper as major constituents; and palladium, iridium, rhodium, tin, nickel, manganese, zinc, iron, and magnesium as minor constituents.

1. Detection of silver and iridium

The sample is dissolved in 15 to 20 cc of dilute aqua regia. If silver is present, the silver chloride that forms on the surface of the pieces of the sample is broken off from time to time with a glass rod. The action of the acid is hastened by heating on the steam bath. When all of the metallic portion of the sample has been dissolved the solution is diluted with water to about 200 cc and allowed to stand on the steam bath until the silver chloride has settled out. The solution is then cooled and the silver chloride is filtered off on a paper. If iridium is present the silver chloride residue will be dark colored. When an alloy in which gold is the predominant metal and which contains iridium is dissolved in aqua regia, all of the iridium is left as an insoluble metallic residue. This will be more fully discussed under the section devoted to the quantitative determination of iridium.

The silver chloride residue should always be examined to determine whether or not it contains iridium. Hot, dilute ammonium hydroxide is poured through the paper on which the residue was filtered until all of the visible particles of silver chloride have dissolved. Any iridium that is present will be left as a black residue on the paper. Paper and residue are digested for 30 minutes on the steam bath in a

small beaker with about 25 cc of dilute ammonium hydroxide. The paper pulp and residue are filtered off and washed thoroughly with hot water containing 3 to 4 cc of ammonium hydroxide per liter. The paper is then burned off in a porcelain crucible. If there is no dark metallic residue in the crucible, iridium is not present in the alloy.

If there is no silver in the alloy, the aqua regia solution of the sample should be carefully filtered through a small paper that has first been treated with filter-paper pulp. The paper is burned off and iridium, if present in the sample, will be left as a dark metallic residue.

To positively identify this residue as iridium, proceed as follows: Transfer the residue to a gold crucible. Add about 1 g of solid sodium hydroxide and 0.5 g of sodium nitrate and fuse the mixture at a low red heat for half an hour. Cool the melt and dissolve it out of the crucible with water. Make the solution acid with hydrochloric acid. Hydrochloric acid must not be added to the solution while it is in contact with the gold crucible. Evaporate almost to dryness. Then add 5 to 10 cc of aqua regia and digest for half an hour. Filter off any unattacked residue. Add 10 to 15 cc of saturated ammonium chloride solution and evaporate to dryness on the steam bath. Add the least amount of cold water necessary to dissolve the salts. Most of the iridium present will appear as very small, heavy, reddish-black crystals of ammonium chloroiridate on the bottom of the beaker. These crystals are quite distinctive in appearance. To further confirm the presence of iridium, evaporate the solution containing the crystals to dryness. Add sulphuric acid in slight excess over the amount required to convert the salts to sulphate. Heat on a hot plate until the sulphuric acid begins to fume. Cool and add a few drops of nitric acid. Upon reheating cautiously on the hot plate, an intense but fugitive blue color will appear in the mixture when as little as a few tenths of a milligram of iridium is present.

2. Detection of tin and iron

The aqua regia solution of the sample, after the silver chloride and iridium have been filtered off, is first examined for the presence of tin. If not more than 20 cc. of dilute aqua regia was used to dissolve the sample, 45 cc. of sodium acetate solution, prepared as directed under

Section III, Reagents, is added[2] and the solution is digested for one hour on the steam bath. Tin, if present, will be thrown down as a flocculent white precipitate. Any iron present in the sample will be precipitated as ferric hydroxide by this reagent. Hence, if the alloy contains tin and iron the precipitate obtained with sodium acetate may be brown. The precipitate is filtered off on a tight paper treated with filter-paper pulp. It is washed well, first with hot 1 per cent solution of sodium chloride, and then with hot 1 per cent solution of ammonium chloride. The ammonium chloride wash water must be kept separate from the main filtrate. If the presence of iron is suspected, a small portion of the precipitate is removed and treated with a little hydrochloric acid. The usual qualitative tests for the detection of small amounts of iron are applied to this solution.[3]

The remainder of the precipitate with the paper is ignited in a porcelain crucible. If iron is absent a white residue of stannic oxide is obtained. To further confirm the presence of tin, a small amount of potassium cyanide is melted in a porcelain crucible, the ignited residue is added, and the fusion continued for about 15 minutes. Tin, if present, will be reduced to a metallic globule, which is separated from the melt and identified as tin by the usual qualitative tests.

3. Detection of gold

The solution of the sample from which silver, iridium, and tin have been removed is evaporated to dryness. About 5 cc of sulphuric acid is added to break up the acetate salts. The mixture is heated until all of the acetic acid has evaporated. About 5 cc of aqua regia is added to redissolve any precipitated metals. The solution is diluted to about 50 cc and saturated with sulphur dioxide. All of the gold will be precipitated in a finely divided metallic form. It is filtered off on a tight paper. The color of the ignited precipitate will serve to identify it as gold.

[2] About 0.6 g of $NaC_2H_3O_2$ should be added for each cubic centimeter of dilute aqua regia used to dissolve the sample. See VII, Determination of tin.

[3] Aluminum, if present in the alloy, will also be precipitated by the sodium acetate. A portion of the precipitate is removed and treated with hydrochloric acid, and the usual qualitative tests for the presence of aluminum are applied to the solution thus obtained.

4. Detection of copper

The filtrate from the precipitation of the gold, being still thoroughly saturated with sulphur dioxide, is treated with sodium hydroxide solution until it is just alkaline. It is then acidified with 9 to 10 drops of hydrochloric acid. Upon addition of sufficient ammonium thiocyanate all of the copper will be precipitated as white cuprous thiocyanate.[4] The precipitate is allowed to settle for several hours and is then filtered off on a tight paper treated with filter-paper pulp. The solution of the precipitate in dilute nitric acid may be used for further confirmation of the presence of copper.

5. Detection of platinum, palladium, and rhodium

(*a*) PALLADIUM.—The filtrate from the precipitation of the copper is evaporated to dryness. About 5 cc of nitric acid is carefully added to the dry salts to destroy the thiocyanate reagent. The nitric acid is then driven off by adding successive portions (about 5 cc each) of hydrochloric acid and evaporating to dryness after each addition of acid. The residue is then taken up with 15 cc of hydrochloric acid and diluted to about 250 cc. A fairly rapid stream of hydrogen sulphide is passed through the solution for half an hour while it is heated on the hot plate to incipient boiling. Platinum, palladium, and rhodium, if present, will all be precipitated as sulphides. The precipitated sulphides are filtered off and washed with hot water. The precipitate and paper are returned to the beaker and digested with 10 cc of dilute aqua regia until all of the sulphides have dissolved. The paper pulp is filtered off. The solution is to be tested for the presence of palladium, platinum, and rhodium. A portion of the solution is removed, diluted to about 15 cc, and 5 to 10 cc of a 1 per cent dimethylglyoxime solution is added. If palladium is present it will immediately form the characteristic lemon-yellow precipitate of palladium dimethylglyoxime. To confirm the presence of palladium, the precipitate is filtered off on a paper and washed well with hot water. The paper and precipitate are burned off and the residue is reduced to metal by heating in a porcelain cru-

[4] Swanger and Wichers: The analytical separation of copper from the platinum metals, *J. Am. Chem. Soc.*, **46**, p. 1814; 1924.

cible in an atmosphere of hydrogen. The metal is dissolved in a few drops of dilute aqua regia. The solution is evaporated to dryness several times with hydrochloric acid to drive off the nitric acid. The residue is taken up with a little water and a drop of hydrochloric acid. A few drops of a 1 per cent solution of potassium iodide added to this solution will form a dense black precipitate if palladium is present. This is a delicate test for small amounts of palladium.

(*b*) PLATINUM.—The remainder of the aqua regia solution of the sulphides, of which a portion was used in testing for palladium, is evaporated to dryness several times with hydrochloric acid to drive off the nitric acid. The residue is taken up with 10 to 15 cc of water and 1 to 2 cc of hydrochloric acid. About 10 cc of a saturated solution of ammonium chloride is then added. Most of the platinum will be precipitated as yellow ammonium chloroplatinate. If nitric acid is present, palladium may also be precipitated as the red ammonium chloropalladate. If only a small amount of platinum is present, it may be necessary to evaporate the solution to dryness on the steam bath, after the addition of the ammonium chloride. By dissolving the salts in the least amount of cold water, the yellow crystals of the chloroplatinate can be detected on the bottom of the beaker, even when as little as a milligram of platinum is present.

A still more delicate test for the detection of platinum is the red color formed when potassium iodide is added to a dilute platinum chloride solution. The solution should first be freed of palladium and nitric acid, and should contain only a very slight amount of hydrochloric acid. A few drops of a 1 per cent solution of potassium iodide added to the cold platinum solution which should have a volume of about 5 cc, will produce a faint red color which upon standing for about half an hour develops to a deep red color when as little as a few tenths of a milligram of platinum is present.

(*c*) RHODIUM.—The mother liquor from the precipitation of the platinum with ammonium chloride will contain most of the rhodium. The presence of rhodium is established by the rose-pink color of the solution. However, the presence of palladium may hide the pink color of the rhodium chloride. Hence, the solution must first be freed from palladium.

The ammonium chloroplatinate is filtered off. The filtrate is evapo-

rated almost to dryness on the steam bath. About 5 cc of dilute nitric acid is added and the solution is digested until the red crystals of ammonium chloropalladate have settled out. It may be necessary to add more ammonium chloride during this treatment to make up for the loss of ammonium chloride by the action of the nitric acid. This red salt is filtered off. The rose-pink color of the filtrate indicates the presence of rhodium.

To further confirm the presence of rhodium, this solution is freed from nitric acid, and a stream of hydrogen sulphide gas is then passed through it while it is heated to incipient boiling. This will precipitate all of the rhodium, together with small amounts of platinum and palladium that were not precipitated by the ammonium chloride. The sulphides are filtered off, ignited in a porcelain crucible, and reduced to metal in a stream of hydrogen. The residue is then fused in a covered porcelain crucible with a few grams of potassium pyrosulphate for about half an hour at a red heat. When the melt is cooled it will have a pink color if the amount of rhodium present is not too large. The melt is dissolved in hot water. Two or three cc of hydrochloric acid and about 1 g of sodium chloride are added and the solution is evaporated to dryness. When the residue is taken up in water the characteristic rose-pink color of rhodium chloride can be seen.

6. Detection of nickel, manganese, zinc, and magnesium

All of the above-named base metals that are present in the sample are contained in the filtrate from the precipitation of platinum, palladium, and rhodium by hydrogen sulphide. Their presence or absence is determined by the methods generally used for the detection of these metals.[5]

[5] Cadmium, although not encountered in any of the alloys that were analyzed in this investigation, may be among the constituents of dental gold alloys. In following the scheme outlined above some of it may be precipitated by hydrogen sulphide along with the platinum, but at the acidity used for this precipitation some of the cadmium will remain in the filtrate. By adjusting the acidity of this filtrate to 0.01 *N* with respect to sulphuric acid the cadmium will be precipitated along with zinc by hydrogen sulphide. The yellow color of the sulphide will serve as an indication of the presence of cadmium.

V. DETERMINATION OF SILVER

With the exception of iron, manganese, and magnesium, all of the constituents of a dental gold alloy are usually determined in the same sample.

The sample is dissolved in dilute aqua regia in a 250 cc beaker covered with a watch glass and heated on the steam bath. Twenty-five cc of dilute aqua regia is sufficient to dissolve a 2 g sample. Silver chloride will be left as an insoluble residue, usually in the form of the small plates of the original sample. It should be broken up from time to time with a glass rod until the alloy is completely decomposed. If tin is present it is essential that the solution be not allowed to evaporate to dryness, as this will cause loss by volatilization of stannic chloride. When the alloy has been completely decomposed 150 to 200 cc of water is added and the solution is digested on the steam bath for about one hour. It is then set aside to cool until the supernatant liquid is perfectly clear, when the silver chloride is filtered off.

If metals of the platinum group are present in the alloy, the silver chloride residue will be discolored by contamination with platinum metals and must be dissolved and reprecipitated. The procedure is as follows: Filter off the silver chloride on a paper and wash well with water. Pour hot dilute ammonium hydroxide on the paper in successive portions until no more of the silver chloride can be seen. If the resulting filtrate is not clear pour it back on the paper until it runs through clear. If iridium is present it will be left as a black metallic residue on the paper. Any platinum or palladium that was present will be in solution along with the silver chloride. Wash the residue several times with hot 1 per cent ammonium hydroxide. Place paper and residue in a small beaker, add 15 to 25 cc of dilute ammonium hydroxide, and digest for half an hour on the steam bath. Filter through a small paper and wash well with hot 1 per cent ammonium hydroxide. Transfer the paper and residue to a weighed porcelain crucible for the determination of iridium. Unite the two ammoniacal filtrates and acidify with nitric acid to reprecipitate the silver chloride. This is filtered off on a Gooch crucible, washed well with water, dried at 110° C., and weighed.

The platinum and palladium contained in the filtrate from the reprecipitation of the silver chloride are recovered and added to the main

solution of the sample; that is, to the filtrate from the first precipitate of silver chloride. The procedure is as follows: Evaporate the filtrate from the reprecipitation of the silver chloride to dryness. Destroy the ammonium nitrate by cautiously adding hydrochloric acid. Evaporate the residue to a small volume and transfer to a porcelain crucible. Continue the evaporation to dryness in the crucible and then add about 10 g of sodium pyrosulphate. Fuse the mixture for about half an hour at a red heat, cool, and dissolve the melt in hot water. Pass hydrogen sulphide through the solution for about half an hour while it is heated to incipient boiling on the hot plate. Filter off the precipitated platinum and palladium sulphides, wash, and ignite to metal in a porcelain crucible. Dissolve the residue in the crucible in a few cc of dilute aqua regia, filter off any silica, and add the solution to the main portion of the sample before the determination of platinum or palladium is made. This rather tedious procedure for the recovery of platinum and palladium is made necessary by the fact that these metals are converted to soluble, nearly colorless ammine compounds when the silver chloride is dissolved in ammonium hydroxide. In the case of platinum this ammine compound is very stable and does not react with the ordinary reagents used for the precipitation of platinum. It must, therfore, be decomposed by ignition at a temperature such as that of a pyrosulphate fusion.

VI. DETERMINATION OF IRIDIUM

Most dental gold alloys that contain platinum also contain a small amount of iridium, usually not over 0.2 per cent. This iridium is probably not added intentionally, but is present as an impurity in the platinum that is used to make up the alloy. Alloys have been encountered that contained as much as 2 per cent of iridium, in which cases it probably was added intentionally.

When an alloy containing iridium, with gold as the predominant constituent, is dissolved in aqua regia, all of the iridium is left behind as an insoluble metallic residue, mixed with silver chloride if silver is present in the alloy. If platinum also is present in the alloy the insoluble residue of iridium may be contaminated with platinum. When the weight of the residue amounts to not more than 0.2 or 0.3 per cent of the sample, the amount of platinum that is with the iridium

is so small that it may be neglected. When larger amounts of iridium are present it is usually necessary to separate the platinum in the residue from the iridium.

This behavior of iridium on dissolving the alloy in aqua regia has been verified by numerous experiments with alloys of known composition as well as in the analysis of a number of commercial alloys. The alloys (5 to 8 g for a charge) were made up from especially purified metals and melted in an Ajax-Northrup high-frequency induction furnace, using a crucible made of zirconium oxide. There was a melting loss ranging from a few tenths of a milligram in the alloys with no silver to 10 or 15 mg in those alloys containing silver. This loss was ascertained to be chiefly silver and did not significantly change the percentage of iridium present. The buttons obtained from the melting were carefully cleaned and rolled out to a thin ribbon. The ribbon was cut into small pieces, a number of which were taken for the sample. The samples were decomposed with dilute aqua regia and the insoluble residue was filtered off.[6] If silver chloride was present it was dissolved with ammonium hydroxide as described under V, Determination of silver. The residue was ignited in a porcelain crucible, first in air to burn off the paper, and then in an atmosphere of hydrogen. The crucible was covered with a Rose lid of fused quartz fitted with a quartz delivery tube for the reduction of the partially oxidized iridium. The residue was weighed as metallic iridium.

The results of the analyses of these alloys are given in *Table 1.*

When platinum was present in the alloy the weight of the insoluble residue was greater than the weight of iridium present in the sample. Each of these residues was examined qualitatively and found to contain platinum, but no silver or gold. No iridium was detected in any of the aqua regia solutions after the insoluble residue of iridium had been filtered off.

[6] In the preparation of these alloys, platinum and iridium were usually added to the gold as a platinum-iridium alloy whose iridium content was known. In several instances the temperature had not been carried high enough for the gold to dissolve completely the platinum iridium alloy. The subsequent treatment of the gold alloy with aqua regia dissolved some of the iridium from the unalloyed platinum-iridium. Hence if the alloy to be analyzed is not homogeneous, not all of the iridium will be obtained as an insoluble residue from the solution of the sample in aqua regia.

TABLE 1

Determination of iridium in alloys of known composition

ALLOY NO.	COMPOSITION	WEIGHT OF BUTTON	WEIGHT OF SAMPLE ANALYZED	WEIGHT OF IRIDIUM PRESENT	IRIDIUM RECOVERED	
					g	Per cent
	per cent	*g*	*g*	*g*		
1	98.75 Au 1.25 Ir	8.7225	2.7668	0.0345	0.0338	1.22
2	95.80 Au 3.36 Pt 0.84 Ir	6.0841	2.1146	.0177	.0231[a]	1.09
3	79.51 Au 10.03 Ag 10.36 Pt 0.10 Ir	8.1042	(A) 3.0237 (B) 3.4585	.0030 .0035	.0044 .0047	.14 .14
4	80.00 Au 9.76 Ag 10.14 Pt 0.10 Ir	8.2923	(A) 3.1707 (B) 3.3909	.0032 .0034	.0050 .0053	.15 .15
5	85.00 Au 5.05 Ag 9.75 Pt 0.20 Ir	5.0008	(A) 2.0527 (B) 2.9436	.0041 .0059	.0045 .0065	.22 .22
6	90.50 Au 4.74 Pt 4.76 Ir	8.4993	(A) 3.1343 (B) 4.0813	.1492 .1942	.1494 .1925	4.77 4.71
7	85.96 Au 4.78 Ag 4.63 Pt 4.62 Ir	8.9046	(A) 3.1057 (B) 4.3358	.1435 .2003	.1488 .1958	4.79 4.51
8	90.00Au 8.00 Pt 2.00 Ir	8.0141	(A) 3.0763 (B) 3.4812	.0615 .0696	.0644 .0689	2.09 1.98
9	79.67 Au 10.14 Ag 8.14 Pt 2.04 Ir	8.0233	(A) 3.3251 (B) 3.8750	.0678 .0790	.0702[b] .0772[b]	2.11 1.99

[a] This weight includes Pt, the amount of which was not determined by the method of fusion with lead.

[b] The weight of the insoluble residue from alloy No. 9 was: (A) 0.0841 g; (B) 0.1032 g. Pt in this residue was separated from the Ir by the method of fusion with lead, leaving the weight of iridium given.

As stated before, when the alloy contains more than a few tenths of 1 per cent of iridium, the platinum contained in the insoluble residue from the solution of the sample in aqua regia should be separated from the iridium.

For this purpose the method described by Gilchrist[7] for the determination of iridium in platinum alloys is recommended. The procedure given here, with the exception of a few minor changes, is quoted from the recommended procedure given in the above-mentioned paper.

Mix at least 5 g of granular test lead with the iridium-platinum residue and fuse the mixture for a period of one hour at a temperature of about 1,000° C. A covered crucible machined from Acheson graphite is suitable for the fusion. The inside of the crucible should be conical with the apex at the bottom. The crucible is best heated in an electric furnace. Do not pour the fusion from the crucible, but allow it to solidify as the iridium has largely settled to the bottom of the crucible.

Brush the cooled lead button free from carbon with a camel's-hair brush and place it in a beaker. Add nitric acid of the concentration of 1 volume of acid (sp. gr. 1.42) to 4 volumes of water, using 1 cc of concentrated acid per gram of lead. Place the beaker on the steam bath or on a hot plate which maintains the temperature of the solution at about 85° C. Disintegration of the lead button is usually complete in about two hours, leaving a rather voluminous grayish-black mass. Dilute the solution to twice its volume and decant the liquid through a tight filter paper treated with filter-paper pulp. Wash the residue thoroughly with hot water and pass the washings through the filter. The residue is not transferred to the filter at this point. The lead nitrate solution and washings are best caught in an Erlenmeyer flask to make it easier to detect the presence of any residue which has passed through the filter. This is done by whirling the liquid in the flask. Any particles of the residue collect at the center of the bottom of the flask. Return the filter to the beaker without ignition.

Add, in order, 15 cc of water, 5 cc of hydrochloric acid, and 1 cc of nitric acid. Heat the solution in the beaker on the steam bath or on a hot plate which maintains the temperature at about 85° C. The lead-platinum alloy is usually completely dissolved within one and one-half hours. Dilute the solution with twice its volume of water and filter through a tight paper,

[7] Determination of iridium in platinum alloys by the method of fusion with lead, *B. S. Sci. Papers*, No. 483; also *J. Am. Chem. Soc.*, **45**, p. 2820; 1923.

similar to the one used for the lead nitrate solution. The iridium, insoluble in aqua regia, is in the form of fine crystals, possessing a bright metallic luster and having a high density. Pass the clear solution through the filter first and then transfer the thoroughly macerated paper. It is very important to examine the beaker to see that no iridium remains. To do this the interior of the beaker is wiped with a piece of filter paper to collect any metal adhering to the sides. Then by whirling a small quantity of water in the beaker any iridium remaining gravitates toward one place, whence it can be removed with a piece of paper. Wash the filter and iridium thoroughly with hot 1 per cent hydrochloric acid. The filtrate and washings containing the platinum should be examined for iridium, which may have passed through the filter, in the manner described under the nitric acid treatment. The last washings should be tested for the absence of lead.

Transfer the washed filter and iridium to a porcelain crucible and dry before igniting in air. After the destruction of the filter paper ignite the iridium strongly. After all carbon is burned out, cover the crucible with a Rose lid, preferably of fused quartz. Introduce into the crucible a stream of hydrogen, burning from the tip of a Rose delivery tube (a quartz tube is preferred). After five minutes remove the burner and a few minutes later extinguish the hydrogen flame by momentarily breaking the current of hydrogen. This is best done by having a section of the rubber delivery tube replaced by a glass tube, one end of which can easily be disconnected. Allow the iridium to cool in an atmosphere of hydrogen and then weigh as metallic iridium.

This weight of iridium is subtracted from the weight of the insoluble iridium-platinum residue. The weight of platinum thus found is added to the weight of the main platinum precipitate obtained as directed under XI, Determination of platinum.

A direct determination of iridium can be made by the lead-fusion method. For this purpose the sample is fused with at least 10 times its weight of granulated test lead. The lead button is disintegrated with nitric acid of the concentration 1 volume of acid (sp. gr. 1.42) to 4 volumes of water, using 1 cc of concentrated acid per gram of lead. The residue from the nitric acid solution is treated with aqua regia, using 15 cc of water, 5 cc of hydrochloric acid, and 0.8 cc nitric acid for each gram of sample taken.

If silver is present it will be left as silver chloride mixed with the iridium residue. The silver chloride is separated from the iridium

by dissolving it in ammonium hydroxide in the manner described under V, Determination of silver.

VII. DETERMINATION OF TIN

For the complete analysis of a dental gold alloy it was necessary to devise a method by which tin could be completely precipitated from a solution containing both hydrochloric and nitric acids or their salts, and which would not interfere with the subsequent determination of the other constituents of the alloy.

It was found that if an excess of sodium acetate over the amount equivalent to the mineral acids present is added to the aqua regia solution of the alloy, the tin will be precipitated completely. The reaction is one of hydrolysis as the presence of the acetate suppresses the H ion concentration to the point where the hydrated stannic oxide is precipitated. The other constituents of the alloy, except iron, do not hydrolyze under these conditions. Fortunately iron is rarely present in a dental gold alloy in a sufficient amount to be significant. The tin precipitate can be filtered off quite easily, but it usually will be contaminated with small amounts of the metals in the mother liquor. However, by dissolving the first precipitate with sulphuric acid and reprecipitating as before, a second precipitate can be obtained free from the other metals that were present in the solution, except iron.

The precipitate is ignited to stannic oxide in a porcelain crucible and weighed. When necessary the amount of iron contained in the ignited residue can be determined and subtracted as oxide from the weight of the mixed oxides.

The procedure for the determination of tin is as follows: After silver chloride and iridium have been filtered off from the aqua regia solution of the sample, sodium acetate is added to the filtrate. Six-tenths of a gram of sodium acetate is added for each cc of dilute aqua regia used to dissolve the sample. When 25 cc of dilute aqua regia is used, 45 cc of sodium acetate solution prepared as directed under III, Reagents, is added.

After the addition of the acetate, the solution is digested for an hour on the steam bath. The tin precipitate is filtered off on a 7 cm paper treated with filter-paper pulp. It is washed well with a

hot 1 per cent solution of sodium chloride. Paper and precipitate are returned to the beaker and 5 cc of sulphuric acid is added. After standing in the cold for a few minutes, the solution is heated on a hot plate, and nitric acid, a few drops at a time, is added until the paper is destroyed. The solution is then cooled, diluted with about 10 cc of water, and filtered through a 5.5 cm paper. A little metallic gold is usually found on the paper. Paper and gold are ignited in a porcelain crucible. The residue is dissolved in a few cc of dilute aqua regia and the solution is added to the main solution of the sample before gold is precipitated.

The solution containing the tin is diluted to about 200 cc and the tin is reprecipitated with ammonium acetate and digested for one hour on the steam bath.

Ammonium acetate instead of sodium acetate is used for the second precipitation because of the difficulty of washing out completely the mother liquor from the precipitate. The subsequent ignition of the precipitate, with ammonium salts present, avoid the error that would arise if alkali salts were present. Ammonium acetate can not be used for the first precipitation of tin because it would form ammonium chloroplatinate with the platinum that is usually present in the alloy.

When 5 cc of sulphuric acid is used to dissolve the first tin precipitate, 45 cc of the ammonium acetate solution prepared as described under III, Reagents, will be sufficient to reprecipitate the tin.

The precipitate is filtered off, washed with a hot 1 per cent solution of ammonium sulphate, and ignited in a porcelain crucible slowly until the paper is burned off, and finally over a blast lamp or Meker burner for about five minutes. The weight of tin is calculated from the weight of the stannic oxide residue.

All of the iron from the sample will be included in this residue. The color of the residue gives an indication as to the amount of iron present. Usually the amount is so small that it can be disregarded. When it is desired to make a separation, the amount of iron in the residue can be determined by a direct analysis of the mixture. The procedure is as follows: Transfer the weighed oxides of tin and iron to a small gold crucible. Add 2 or 3 g of solid sodium hydroxide and fuse the mixture for half an hour at a low red heat. Cool the melt,

take up in water, and acidify with hydrochloric acid. A clear solution of all the tin and iron is obtained. Determine the iron in the solution by the usual colorimetric thiocyanate method. The details of this method may be found in any standard work on quantitative analysis. The presence of tin in the solution does not interfere with the iron determination. Subtract the weight of iron, calculated as Fe_2O_3, from the weight of tin and iron oxides first found. The weight of tin is then calculated from the corrected weight of stannic oxide.

The amount of iron contained in the sample may be calculated from the weight of iron as found above by subtracting from it the iron contained in the reagents that have been used in the analysis up to this point.

TABLE 2

Precipitation of tin from a solution of pure tin

[Factor used is 0.7877]

WEIGHT OF PURE TIN IN GRAMS	WEIGHT OF SnO_2	CALCULATED AS Sn
	g	g
0.1356	0.1709	0.1346
.1138	.1441	.1135
.1009	.1284	.1011
.1076	.1374	.1082

Results obtained with the above method of precipitating tin from solution whose tin content was known, are given in *Tables 2*, *3*, and *4*.

In the first series of experiments, samples cut from a bar of pure tin[8] were dissolved in aqua regia made up from 4 cc of hydrochloric acid, 1 cc of nitric acid, and 20 cc of water.[9] Thirty cc of ammonium-acetate solution (containing 10 g $NH_4C_2H_3O_2$) were added to each solution. The precipitate was filtered off and ignited to stannic oxide (SnO_2). The results are given in *Table 2*.

In the next series of experiments, iron from a standard iron solution was added to each sample of tin after it had been dissolved in dilute

[8] The tin used was cut from a bar of tin issued by the Bureau of Standards as a melting point standard and contained over 99.99 per cent tin.

[9] Aqua regia was used to dissolve the tin to make the solution comparable to a solution of a dental gold alloy with respect to mineral acids.

aqua regia. Tin and iron were precipitated together by means of ammonium acetate solution, filtered off, and ignited. The iron in the ignited residue was determined by the method described for this separation. The results are given in *Table 3.*

In the third series of experiments known weights of pure gold, platinum, and copper were added to the sample of pure tin. The mixture was dissolved in dilute aqua regia. Tin was precipitated

TABLE 3

Precipitation of tin from a solution of tin and iron

SAMPLE	WEIGHT Sn	WEIGHT Fe	WEIGHT SnO_2 AND Fe_2O_3 FOUND	WEIGHT Fe DETERMINED	WEIGHT Fe AS Fe_2O_3	CORRECTED SnO_2	Sn
	g	g	g	g	g	g	g
A	0.0523	0.0005	0.0677	0.0006	0.0008	0.0669	0.0527
B	.0527	.0008	.0685	.0007	.0010	.0675	.0531
C	.0729	.0010	.0941	.0010	.0014	.0927	.0730
D	.0558	.0020	.0722	.0022	.0031	.0691	.0544
E	.0512	.0030	.0695	.0033	.0047	.0648	.0510

TABLE 4

Precipitation of tin in the presence of gold, platinum, and copper

METAL	SAMPLE A		SAMPLE B		SAMPLE C	
	Weight added	Weight recovered	Weight added	Weight recovered	Weight added	Weight recovered
	g	g	g	g	g	g
Sn	0.0795	0.0802	0.0795	0.0799	0.0901	0.0906
Au	.5655	.5651	.6273	.6274	.6288	.6283
Pt	.7560	.7567	.7576	.7572	.7584	.7600
Cu	.0759	.0758	.0775	.0781	.0776	.0780

with sodium acetate solution. The precipitate was filtered off, dissolved, and reprecipitated with ammonium acetate, according to the procedure already described. Gold, platinum, and copper were recovered from the filtrates by the methods ordinarily used for the determination of these metals in the analysis of a dental gold alloy. The results, given in *Table 4*, show that the reagents used for the determination of tin do not interfere with the subsequent determination of the other metals in the alloy.

The solution of the sample, after the separation of tin, is prepared for the determination of the gold. The filtrate from the first precipitation of the tin is evaporated to dryness on the steam bath. About 5 cc of sulphuric acid is added and the mixture is heated on the hot plate until fumes of sulphuric acid appear. This will eliminate all of the acetic acid and acetates. (The presence of acetic acid retards the precipitation of gold with sulphur dioxide.) The residue is cooled and diluted with 15 to 20 cc of water. About 5 cc of aqua regia is added and the solution is heated on the steam bath until any metals precipitated by the treatment with sulphuric acid are again dissolved.

The filtrate from the second precipitation of the tin contains the metals except gold[10] that contaminated the first tin precipitate. The solution must not be added to the first filtrate because the ammonium salts present would cause the precipitation of ammonium chloroplatinate. To recover the metals present, the solution is saturated with hydrogen sulphide. The small amount of sulphides thus obtained may contain copper, platinum, palladium, and zinc. The sulphides are filtered off, dissolved in a few cc of dilute aqua regia, and the solution is added to the filtrate from the first precipitation of the tin. Nickel, if present, will be left in the filtrate from the sulphides, and is best precipitated with dimethylglyoxime, the precipitate being added to the main precipitate of nickel when that is obtained.

VIII. DETERMINATION OF GOLD

If a solution containing gold (the acidity of the solution may vary within a rather wide range) is saturated with sulphur dioxide, the gold will be precipitated quantitatively as metal. If platinum and palladium are present the precipitated gold will carry appreciable amounts of these metals and the gold must be reprecipitated. The impure precipitate is dissolved in aqua regia. The gold is reprecipitated from this solution with oxalic acid and is thus obtained free from platinum and palladium. Oxalic acid can not be used for the first precipitation of the gold in the presence of copper, because it would precipitate copper oxalate.

[10] Directions have already been given in this section for the disposition of this small amount of gold.

The extent to which platinum and palladium are carried down with the gold by the precipitation with sulphur dioxide was investigated. Six samples of an alloy containing gold, platinum, palladium, and copper were used. The gold was precipitated with sulphur dioxide and redissolved in dilute aqua regia. From this solution the gold was reprecipitated with oxalic acid, and the mother liquor was examined for platinum, palladium, and copper. The amounts of

TABLE 5

Amount of contamination of gold when precipitated by sulphur dioxide in the presence of platinum and palladium

SAMPLE	WEIGHT OF Au, Pt, AND Pd IN EACH SAMPLE			WEIGHT OF Pt AND Pd RECOVERED FROM FILTRATE OBTAINED BY REPRECIPITATING Au WITH OXALIC ACID	
	Au	Pt	Pd	Pt	Pd
	g	g	g	g	g
A	0.7570	0.1640	0.0757	0.0103	0.0043
B	.8664	.1877	.0866	.0124	.0073
C	1.1520	.2495	.1152	.0182	.0174
D	1.1493	.2490	.1150	.0172	.0151
E	.8669	.1878	.0867	.0094	.0034
F	.8581	.1859	.0858	.0084	.0045

TABLE 6

Amount of contamination of gold when precipitated by sulphur dioxide in the presence of platinum

SAMPLE	WEIGHTS OF Au AND Pt IN EACH SAMPLE		WEIGHT OF Pt RECOVERED FROM FILTRATE OBTAINED BY REPRECIPITATING Au WITH OXALIC ACID
	Au	Pt	
	g	g	g
A	1.3576	0.2026	0.0091
B	1.4316	.2137	.0067

platinum and palladium that were recovered are given in *Table 5*. Copper was not detected. No copper, platinum, or palladium was detected in the reprecipitated gold.

Two samples of another alloy containing gold and platinum among other metals, but no palladium, were also analyzed. The gold was precipitated with sulphur dioxide, dissolved in aqua regia, and reprecipitated with oxalic acid. See *Table 6*.

The detailed procedure for the determination of gold is as follows: If the alloy contains no tin the filtrate from the silver chloride is evaporated to dryness on the steam bath without waiting for the addition to it of the metals to be recovered from the filtrate left from the reprecipitation of the sliver chloride. The residue is taken up with a little water followed by 10 cc of hydrochloric acid. Most of the nitric acid will thus be driven off and sulphur dioxide will readily destroy the rest of it. If the alloy contains tin the filtrate from the precipitation of tin is prepared for the precipitation of the gold as previously described. In either case, the solution is diluted to about 200 cc. About 50 cc of a saturated solution of sulphur dioxide in water is added and the solution is digested on the steam bath for about one hour. Additional sulphur dioxide solution (10 to 20 cc) is then added and the solution is set aside to cool. If the solution when cold still smells strongly of sulphur dioxide the precipitation of the gold is complete. The supernatant liquid is poured through a tight paper which has been treated with filter-paper pulp. The dark-colored precipitate is not transferred to the paper at this point, but is washed thoroughly in the beaker by decantation with a hot 1 per cent solution of hydrochloric acid. The paper is washed thoroughly and, together with the small amount of gold caught on it, is returned to the beaker. The filtrate should be examined for any gold that may have passed through the paper. If free from gold it is set aside for the next determination.

The impure precipitate is dissolved in 20 cc of dilute aqua regia. The solution is filtered from the paper pulp, which is very thoroughly washed with hot 1 per cent hydrochloric acid. The solution is then evaporated to dryness on the steam bath. Two or three cc of hydrochloric acid is added and the solution is again evaporated to dryness. This is repeated twice, or until it is certain that all of the nitric acid has been eliminated. The precipitation of gold with oxalic acid is not complete in the presence of nitric acid. The residue is taken up with 5 cc of hydrochloric acid, 8 to 10 drops of sulphuric acid and 150 cc of water. Fifty cc of a saturated solution of oxalic acid is added and the solution is boiled for not more than 15 minutes. Prolonged boiling with oxalic acid will precipitate some of the platinum or palladium present. Ten cc more of the oxalic acid is added and

the solution is boiled for a minute or two. If no further visible precipitation of gold takes place the solution is set on the steam bath for not less than four hours. The gold will be completely precipitated as a bright metallic sponge. It is filtered off on a paper that has been treated with filter-paper pulp. Great care must be taken to transfer all of the heavy gold particles from the beaker. The paper and the precipitate are ignited in a porcelain crucible and the residue is weighed as metallic gold.

The filtrate from the reprecipitation of the gold contains any platinum and palladium that were precipitated with the gold by sulphur dioxide. To recover the platinum and palladium the filtrate is evaporated to dryness, 5 cc of sulphuric acid is added to the residue and the mixture is again evaporated on the hot plate until nearly all of the sulphuric acid has been driven off. The oxalic acid will thus be eliminated. It is quite necessary to destroy the oxalic acid at this point as its presence in the solution would interfere with the subsequent determination of the copper.

The residue is digested with 10 cc of dilute aqua regia until all of the precipitated metals are again dissolved. The solution is filtered off from any silica (from the glassware) and added to the filtrate from the first precipitation of the gold.

IX. DETERMINATION OF PALLADIUM

Silver, iridium, tin, and gold, if present, have now been separated and determined in the order named. Palladium is determined next. If the acid solution containing palladium is treated in the cold with an alcoholic solution of dimethylglyoxime, the palladium will be quantitatively separated as a flocculent yellow precipitate of palladium dimethylglyoxime.[11] None of the constituents of a dental gold alloy except gold interferes with this precipitation. Hence, gold is removed first. The voluminous character of the precipitate makes it difficult to separate the mother liquor completely. When great accuracy is desired it is well to dissolve the first precipitate in nitric acid or in aqua regia and then reprecipitate the palladium with the

[11] Davis, C. W.: Separation of palladium and platinum by means of dimethylglyoxime, *Bur. Mines Reports of Investigations*, Serial No. 2351; May, 1922.

same reagent. The filtrate from the reprecipitation usually contains 1 or 2 mg of platinum.

The precipitate is either filtered on a Gooch crucible and the amount of palladium calculated from the weight of palladium dimethylglyoxime ($PdC_8H_{14}N_4O_4$) or it is ignited to metallic palladium and weighed as such. When the amount of palladium is small the first method is preferred.

The procedure for the determination of palladium is as follows: The metals recovered from the reprecipitation of the silver chloride as well as the platinum and palladium recovered from the reprecipitation of the gold, all dissolved in aqua regia, are added to the main solution containing the palladium; that is, the filtrate from the first precipitation of gold. This solution is evaporated to dryness on the steam bath. The residue is digested with 10 cc of dilute aqua regia until all of it is in solution. It is diluted to about 250 cc and cooled to room temperature. Enough of a 1 per cent solution of dimethylglyoxime in alcohol is added to precipitate all of the palladium. The solution must not be heated lest some of the platinum be precipitated. It requires 2.2 g of the solid reagent to precipitate 1 g of palladium. About 10 per cent over the theoretical amount is added.

After standing for one hour the precipitate is filtered off on a paper of suitable size and washed well with hot water. Additional reagent is added to the filtrate to ascertain whether or not all of the palladium has been precipitated. The precipitate with the paper is returned to the beaker and dissolved, on the steam bath, in 25 cc of dilute aqua regia. The paper pulp is filtered off, washed with hot water, and ignited in a porcelain crucible. Any metallic residue is dissolved in the crucible with a few cc of dilute aqua regia and the solution is added to the main solution of the palladium. This solution is diluted to about 250 cc and the palladium is precipitated as before. The precipitate is filtered on a Gooch crucible, washed thoroughly with hot water, dried at 110°C., and weighed. The weight of the precipitate multiplied by 0.3167 gives the weight of palladium.

If the amount of palladium exceeds approximately 0.1 g, the filtration of the precipitate on a Gooch crucible becomes very tedious and it may be filtered on a paper instead and ignited to metal. The

ignition must be done with caution to prevent loss of palladium. After washing and allowing to drain, the paper with the precipitate is removed from the funnel and carefully wrapped in another ashless filter paper. The whole is placed in a porcelain crucible and dried at a temperature not exceeding 110° C. The crucible is then covered with a Rose lid, and hydrogen is led in by means of a Rose delivery tube while the crucible is heated gently to decompose the compound. After this has been done, the Rose cover is removed and the paper is burned off in air. The residue is reduced to metallic palladium by heating strongly for several minutes in an atmosphere of hydrogen. The burner is then removed and the flame of the burning hydrogen is extinguished by momentarily interrupting the stream of hydrogen without removing the Rose lid from the crucible. The hydrogen is allowed to flow until the crucible has cooled to room temperature.

While cooling in the atmosphere of hydrogen the palladium sponge will absorb a good deal of the gas. Most of this can be removed by heating the crucible just to redness for a moment. This will partially oxidize the sponge, which will take on a purplish color. Then by heating the crucible on a hot plate and moistening the sponge from time to time with a few drops of formic acid the oxidized sponge is again reduced. The color of the fully reduced sponge is light gray.

The filtrates from the precipitation of palladium are united and evaporated to dryness. The excess of dimethylglyoxime is destroyed by adding about 5 cc of nitric acid and digesting on the steam bath. The solution is again evaporated to dryness. The residue is then digested with 10 cc of hydrochloric acid and enough water to dissolve the salts present.

X. DETERMINATION OF COPPER

Copper is determined in the filtrates from the precipitation of palladium. Usually it must be separated from platinum. This is done by precipitating the copper as cuprous thiocyanate.[12] Although copper may be separated in this way from both palladium and platinum and might be determined immediately after the precipitation of the gold with sulphur dioxide, palladium shows some tendency

[12] Swanger and Wichers: The analytical separation of copper from the platinum metals, *J. Am. Chem. Soc.*, 46, p. 1814; 1924.

to contaminate the precipitate of cuprous thiocyanate. For this reason it is recommended that palladium be separated before the determination of copper is made.

The solution containing the copper and platinum is treated with sulphur dioxide. This treatment converts the platinum to a soluble sulphite. In this condition platinum does not form a precipitate with the ammonium thiocyanate that is used to precipitate the copper. The cuprous thiocyanate is filtered off and ignited and the residue is reduced to metallic copper.

The procedure is as follows: The filtrate from the precipitation of palladium, having been treated as described at the end of Section IX, Determination of palladium, is examined for any insoluble residue. Silica from the glassware and a small amount of an insoluble platinum compound are often present. They are filtered off on a small paper and ignited in a porcelain crucible. The residue is digested in the crucible with 3 or 4 cc of dilute aqua regia and the solution is filtered from the silica and added to the main filtrate.

Fifty cc of a saturated solution of sulphur dioxide in water is added to the copper solution, which is then heated on the steam bath for about half an hour. The sulphur dioxide will reduce the copper to the cuprous condition and convert the platinum to sulphite. The solution is set aside to cool to room temperature. If it still has a strong odor of sulphur dioxide, the reduction may be considered complete. Otherwise more sulphur dioxide is added until an excess is present. The solution, diluted to about 300 cc, is just neutralized with sodium hydroxide. Ammonium hydroxide must not be used because it might cause the formation of ammine compounds of platinum. When the addition of 1 drop of sodium hydroxide solution causes a permanent cloudiness (precipitation of cuprous hydroxide), 8 to 10 drops of hydrochloric acid are added. The solution should now be clear and the odor of sulphur dioxide should be quite noticeable. Ammonium thiocyanate dissolved in saturated sulphur dioxide solution is added dropwise from a pipette with constant stirring. Ten cc of a 4 per cent solution of ammonium thiocyanate is sufficient to precipitate 100 mg of copper. Usually 30 cc is enough to precipitate all of the copper from a 2 g sample of a dental gold alloy.

The precipitate is allowed to settle for at least three or four hours.

It is best to set the solution aside overnight to allow the precipitate to coagulate. The supernatant liquid will then be perfectly clear and of a light straw color. The precipitate should be pure white. If it is brown it is probably contaminated with platinum and should be reprecipitated.

The precipitate is filtered off on a tight paper treated with filter-paper pulp. It is washed free from alkali salts with a cold 1 per cent solution of ammonium sulphate.

If the copper is to be reprecipitated, the paper and precipitate are returned to the beaker. The cuprous thiocyanate is decomposed by digesting it with 20 cc of dilute nitric acid. The paper pulp is filtered off and ignited in a porcelain crucible. This will usually leave a small residue of copper and platinum which is dissolved in a few cc of dilute aqua regia. This solution is added to the main solution of the copper. The excess of nitric acid is evaporated off. The residue is taken up with 3 or 4 cc of hydrochloric acid and a little water. The solution is diluted to about 300 cc and the copper is reprecipitated exactly as before. The precipitate is filtered off on a paper, as before, and washed free from alkali salts.

The paper and precipitate are placed in a porcelain crucible and dried at 110°C. The crucible is covered with a Rose lid and hydrogen is led in by means of a Rose delivery tube. The crucible is then heated over a low flame of a Bunsen burner. When the cuprous thiocyanate has been completely broken up, the Rose lid is removed and the paper is burned off in air. The residue consists of copper oxide, the weight of which may be used to calculate the weight of copper. However, it is recommended that the oxide be reduced and cooled in hydrogen and weighed as metallic copper. If free from impurities, the resulting sponge will have a bright characteristic copper color.

XI. DETERMINATION OF PLATINUM

The filtrate from the precipitation of copper is evaporated to dryness. The excess of thiocyanate is destroyed by adding 5 to 10 cc. of nitric acid and digesting the mixture on the steam bath for about half an hour. The solution is again evaporated to dryness. The nitric acid is completely expelled by heating the residue on the hot

plate with 5 to 10 cc of sulphuric acid until fumes of sulphuric acid appear. The residue is cooled and digested with 20 cc of dilute hydrochloric acid. The solution is finally diluted to about 100 cc and boiled to put all of the platinum compounds in solution. The solution will usually contain a small amount of silica. This is filtered off and ignited in a porcelain crucible. The residue is leached with dilute aqua regia to dissolve the small amount of platinum it usually contains. This solution is evaporated separately to expel the nitric acid and is then taken up with hydrochloric acid and added to the main solution containing the platinum.

This solution may now contain platinum, rhodium, nickel, zinc, manganese, magnesium, and, if the basic acetate separation for tin was not used, all of the iron.

Hydrogen sulphide will precipitate platinum and rhodium quantitatively from this solution and will separate them from any of the above-named base metals that may be present. When rhodium is absent the precipitated sulphide is filtered off, ignited to metal, and weighed as platinum.

The precipitation of platinum by hydrogen sulphide takes place best in a solution containing some sulphuric acid. When hydrochloric acid alone is present, the sulphide has a tendency to stick to the sides of the beaker so that it can not be wiped off. When both acids are present, the beaker can be wiped out clean by using small pieces of moistened filter paper.

The warning may here be repeated that ammonium hydroxide must not be added to any of the solutions when platinum is present, and if ammonium salts are present the solution must not be made alkaline with sodium hydroxide. Free ammonia in a solution containing platinum will form soluble platinum ammines which can not be quantitatively precipitated by hydrogen sulphide. This was referred to under V, Determination of silver, and a method was given there for the recovery of the platinum from the ammine compounds.

The solution, having been treated to eliminate the excess of thiocyanate reagent, nitric acid, and nitrates as described above, is diluted to about 300 cc. The acidity of the solution will range from 1 to 1.5 *N*. A fairly rapid stream of hydrogen sulphide is passed

through the solution for at least half an hour while it is heated to incipient boiling on the hot plate. The sulphide may be filtered off on a paper at once, as the precipitation is complete in the hot solution. The precipitate is washed thoroughly with hot 1 per cent hydrochloric acid. The filtrate is reserved for the next determination (see under XIII, Determination of zinc).

Paper and precipitate are placed in a porcelain crucible and ignited in air. The ignition is finished over the full heat of a Bunsen burner, to insure elimination of sulphur. The residual sponge is weighed as platinum (when rhodium is absent from the sample).

When great accuracy is desired in the determination of platinum, this ignited sponge is dissolved in 10 cc of dilute aqua regia and the solution is evaporated to dryness on the steam bath. Nitric acid is expelled by adding 2 or 3 cc of hydrochloric acid and repeating the evaporation to dryness. The residue is taken up with 20 cc of dilute hydrochloric acid and 2 or 3 cc of sulphuric acid. The solution is diluted to about 300 cc and the precipitation of the platinum with hydrogen sulphide is repeated. In this way any error due to the presence of alkali salts in the first precipitate is eliminated.

If the insoluble residue left when the original sample was dissolved in aqua regia was treated for the separation of platinum from the iridium as described under VI, Determination of iridium, the weight of platinum thus found is added to the weight of the ignited sulphide above, to give the total weight of platinum.

XII. DETERMINATION OF RHODIUM

In following the scheme of separations thus far outlined, rhodium, if present, is precipitated together with platinum as a mixture of sulphides after silver, iridium, tin, gold, palladium, and copper have been removed from the solution of the sample. The mixed sulphides are filtered off and ignited, first in air, then in hydrogen, and weighed as metallic platinum plus rhodium.

Separation of rhodium from the platinum is best made by the method described by Wichers.[13] This method is based upon the hydrolysis of rhodium in a solution of platinum and rhodium chlorides

[13] Edward Wichers: The analytical separation of rhodium from platinum, *J. Am. Chem. Soc.*, **46**, p. 1818; 1924.

using barium carbonate as the hydrolytic agent. The procedure is as follows: The weighed sponge of platinum and rhodium is transferred to a beaker and digested on the steam bath with 15 to 20 cc of aqua regia. A little of the acid should be poured into the crucible in which the sponge was ignited to dissolve any metal adhering to the walls. The sponge generally dissolves completely. If there is a residue the solution is poured off and the residue is washed by decantation. Fresh portions of acid are added until it is certain that no more of the residue will dissolve. The residue may be considered to be rhodium. It is filtered off and ignited in the weighed porcelain crucible that is to be used for the determination of rhodium.

The solution of platinum and rhodium is evaporated nearly to dryness to expel most of the excess acids and is then diluted to about 200 cc. The free acid in the solution is neutralized with sodium hydroxide solution, using 4 to 8 drops of a 0.4 per cent solution of cresol red as indicator. The alkaline color of the indicator need not persist for more than a few seconds. A freshly prepared mixture consisting of 5 cc of a solution containing 90 g of crystallized barium chloride per liter, and 5 cc of a solution containing 36 g of anhydrous sodium carbonate per liter is added to precipitate the rhodium. After the suspension of barium carbonate is added the solution is rapidly heated to boiling and boiled for two minutes. The residue is filtered off, washed several times with a hot 2 per cent solution of sodium chloride, returned, together with the paper, to the beaker, and digested with 25 cc of hydrochloric acid (1 volume of hydrochloric acid diluted with 4 volumes of water) until solution is complete. The presence of barium carbonate with the rhodium hydroxide may be noted by the evolution of carbon dioxide when the acid is added. If no barium carbonate is present the platinum-rhodium solution should be given a second treatment. If the first precipitate contains barium carbonate the filtrate may be acidified with hydrochloric acid and set aside for the subsequent recovery of platinum.

After the mixture of barium carbonate and rhodium hydroxide has dissolved in hydrochloric acid, the solution is diluted somewhat and filtered from the paper pulp. The solution is again treated with barium carbonate exactly as before. Care should be taken not to add an excess of sodium hydroxide in the preliminary neutralization.

If the amount of rhodium present is very small, it is better to leave the solution slightly acid before adding barium carbonate. The period of boiling should be extended to three minutes. The precipitate is handled as before and a third precipitation made if desired. For mixtures of platinum and rhodium containing 1 per cent or less of rhodium, two precipitations should be sufficient, unless the first precipitate was for some reason unduly contaminated with platinum.

The final solution of rhodium chloride and barium chloride is diluted to about 150 cc. It contains about 5 cc of hydrochloric acid. Rhodium is precipitated as sulphide by passing a fairly rapid stream of hydrogen sulphide for 30 to 45 minutes while the solution is heated to incipient boiling on the hot plate. The precipitated rhodium sulphide should be filtered off at once. If the solution is allowed to stand for some time after the precipitation is completed, some of the barium present may be converted to sulphate and be included with the rhodium sulphide. The precipitate is washed with a hot 1 per cent solution of ammonium chloride. The filtrate and wash water are discarded. The precipitate and paper are ignited in the crucible containing the insoluble residue from the solution of the mixed platinum-rhodium sponge. The ignited sulphide is finally reduced and cooled in an atmosphere of hydrogen, using a Rose lid and delivery tube. The residue is weighed as metallic rhodium. It should have a clean, light-gray color.

The weight of rhodium thus obtained is subtracted from the weight of the mixed sponge of platinum and rhodium to get the weight of platinum in the sample.

XIII. DETERMINATION OF ZINC

The solution of the sample, after the separation of platinum, or platinum and rhodium, as sulphide may contain one or more of the following metals: Zinc, nickel, manganese, magnesium, and also iron if not previously removed by the basic acetate method. Methods that are in general use for the determination of these base metals, and that may be found in any standard work on quantitative analysis, are applicable here. The methods given in this paper for the determination of these metals are those that were actually used in this laboratory for the analysis of a number of commercial dental gold alloys.

Zinc is determined by precipitating it with hydrogen sulphide from a solution which is 0.01 *N* with respect to sulphuric acid.[14] The zinc sulphide is ignited to oxide and the amount of zinc is calculated from the weight of the oxide (ZnO).

The solution, after filtering off the platinum sulphide (sulphides of platinum and rhodium, if rhodium is present) as described under XI, Determination of platinum, is evaporated to dryness on the steam bath. Chlorides and hydrochloric acid are eliminated by heating the residue on the hot plate until copious fumes of sulphuric acid are evolved. It may be necessary to add sulphuric acid. The residue is cooled and taken up with water. Any silica present is filtered off. The solution is neutralized with sodium or ammonium hydroxide, using methyl red as indicator. Enough standard sulphuric acid is then added to make the solution 0.01 *N* at a volume of about 350 cc. A rapid stream of hydrogen sulphide (at least eight bubbles per second) is passed through the solution at room temperature for half an hour. The zinc sulphide is allowed to settle for at least one hour. The precipitate is filtered off on a tight paper treated with filter-paper pulp. It is washed with a cold 1 per cent solution of ammonium sulphate, and ignited to oxide in a porcelain crucible. The paper is first charred, after which the carbon is slowly burned off. The residue is then carefully ignited, finishing at a temperature of not over 900° C.

XIV. DETERMINATION OF NICKEL

Nickel is determined in the filtrate from the precipitation of zinc by the well-known Tschugaeff-Brunck method of precipitation with dimethylglyoxime. The procedure is as follows: The filtrate from the precipitation of zinc is boiled to expel the hydrogen sulphide. One or two cc of sulphuric acid is added before the solution is heated to prevent the precipitation of nickel sulphide from the hot, slightly acid solution. If any sulphur separates out during the boiling it is destroyed by adding bromine water until the solution has cleared up. The boiling is continued until most of the bromine has been expelled. Two or three cc of a saturated tartaric-acid solution are added to

[14] F. G. Breyer, *International Congress of Applied Chemistry*, 25, p. 7; (1912).

prevent the subsequent precipitation of iron with the nickel. Most of the excess acid is then neutralized with ammonium hydroxide. Enough of a 1 per cent solution of dimethylglyoxime in alcohol is added to the hot solution, which should be just barely acid, to precipitate all of the nickel. It requires 4 g of dimethylglyoxime to precipitate 1 g of nickel. About 10 per cent excess over the theoretical amount should be added. Enough ammonium hydroxide is then added to make the solution slightly ammoniacal. Care must be used not to have too much free ammonia present. The solution is set on the side of the steam bath for half an hour. The precipitate is then filtered off on a Gooch crucible, washed well with hot water, and dried at 110° C. The weight of the precipitate multiplied by 0.2032 gives the weight of nickel.

Any nickel that may have been recovered from the reprecipitation of tin as described under VII, Determination of tin, is added to the main precipitate of nickel.

XV. DETERMINATION OF MANGANESE

Manganese may be determined in the filtrate from the determination of nickel by oxidizing the manganese to permanganic acid with sodium bismuthate and titrating the permanganic acid with standard ferrous sulphate solution. The presence of interfering salts in the solution makes it necessary first to separate the manganese from the solution. To avoid this rather difficult separation it is recommended that manganese be determined in a separate sample. The procedure is as follows: The sample (about 0.5 g will usually be sufficient) is dissolved in 10 cc of dilute aqua regia. The solution is evaporated to dryness and the residue is taken up with 5 cc of hydrochloric acid and 50 cc of water. Without previously filtering off the silver chloride, hydrogen sulphide is passed through the solution for half an hour while it is heated to incipient boiling on the hot plate. The sulphides of copper, platinum, gold, etc., are filtered off and discarded.

The filtrate is evaporated to dryness. About 5 cc of sulphuric acid is added and the solution is heated on the hot plate until copious fumes of sulphuric acid are evolved. The residue is cooled, the sides of the beaker are washed down with water, and the solution is again heated until most of the sulphuric acid has been evaporated. The

residue is taken up with 50 cc of nitric acid (sp. gr. 1.135) and the solution is boiled to expel oxides of nitrogen. The solution is cooled, and 0.5 g of sodium bismuthate (free from manganese) is added. The solution is then heated until the pink color of the permanganate disappears and a precipitate of manganese dioxide has formed. More of the bismuthate is added if manganese dioxide does not precipitate. The solution is cleared by adding a few drops of a saturated solution of sodium bisulphite or other suitable reducing agent that is free from chlorides. Oxides of nitrogen and sulphur are expelled by boiling. The solution is cooled to 15°C. and an excess of sodium bismuthate is again added, the solution is agitated, and let stand for a few minutes. The solution is diluted with 50 cc of 3 per cent nitric acid (free from nitrous acid) and filtered through asbestos. The residue is washed with 3 per cent nitric acid until the washings run through colorless. Three cc of phosphoric acid (sp. gr. 1.71) are added to the combined filtrate and washings to destroy the color due to any iron that may be present. The solution is titrated with standardized ferrous sulphate and potassium permanganate solutions.

XVI. DETERMINATION OF IRON

The determination of iron is rarely necessary in the complete analysis of a dental gold alloy. If it is required, a separate sample should be used. The sample (about 0.5 g) is dissolved in 10 cc of dilute aqua regia. The hydrogen sulphide metals and silver chloride are removed in the same way as directed for the manganese determination. The filtrate is boiled to expel the hydrogen sulphide. Two or three cc of nitric acid are added, and the solution is boiled to oxidize the iron to the ferric condition. The iron is precipitated by adding an excess of ammonium hydroxide. The precipitate of ferric hydroxide is filtered off and ignited to ferric oxide. The weight of iron is calculated from the weight of the ferric oxide (Fe_2O_3).

In an alloy containing tin, a determination of iron will already have been made in the process of purification of the tin precipitate as directed under VII, Determination of tin, and another determination of iron will not be necessary.

If the amount of iron in the solution is too small to be determined gravimetrically, it may be determined by a colorimetric method

using thiocyanate as the reagent. This method is in such general use that it is not considered necessary to give the details here.

XVII. DETERMINATION OF MAGNESIUM

Magnesium is rarely present in a dental gold alloy. A separate sample should be taken for the determination. As the amount of magnesium will usually be small, not less than 1 g of sample should be used. The magnesium is precipitated as magnesium ammonium phosphate according to the method of B. Schmitz. The solution of the alloy must be freed from all of the other metals before magnesium is precipitated. The procedure is as follows: The sample is dissolved in 15 cc of dilute aqua regia. The metals precipitable by hydrogen sulphide in acid solution are removed along with the silver chloride as described under XV, Determination of manganese. The filtrate is transferred to an Erlenmeyer flask and the free acid is neutralized with ammonium hydroxide. Two or three cc excess of ammonium hydroxide are added. Hydrogen sulphide is again passed into the cold solution to saturation, whereby manganese, nickel, zinc, and iron are precipitated. A second like amount of ammonium hydroxide is now added. The flask, filled to the neck and corked, is set aside for at least 12 hours. The precipitate is then filtered off. The filtrate containing the magnesium is evaporated to about 100 cc and acidified slightly with hydrochloric acid. Any sulphur that separates out is destroyed by adding bromine water and boiling. The boiling is continued until most of the excess bromine is expelled.

The slightly acid solution, having a volume of not over 100 cc, is heated to boiling and treated with an excess of sodium or ammonium phosphate or microcosmic salt (10 per cent solutions). Ammonium hydroxide is then added, drop by drop, with constant stirring, until the solution is alkaline. A volume of ammonium hydroxide (sp. gr. 0.96) equal to one-third of the volume of the magnesium solution is then added. The solution is cooled and the precipitate is allowed to settle for at least two hours. The precipitate is filtered off on a paper, washed with an ammonium hydroxide solution containing 50 cc of ammonium hydroxide per liter, and ignited to magnesium pyrophosphate. The amount of magnesium is calculated from the weight of the ignited residue.

TABLE 7

Complete analyses of typical dental gold alloys

ALLOY NO.	SAMPLE	Ag	Ir	Sn	Au	Pd	Cu	Pt	Rh	Zn	Ni	Fe	TOTAL
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	A	7.14	0.15	0.82	71.31	.....	9.86	10.65	....	0.08	....	....	99.87
	B	7.12	.13	.81	71.25	.....	9.90	10.59	....	.07	....	....	100.01
2	A	.....	1.23	....	75.60	16.07	.....	6.95	....	.06	....	....	99.91
	B	.....	1.21	....	75.55	16.04	.....	6.97	....	.07	....	....	99.84
3	A	.09	....	....	90.60	.....	.....	9.31	....	.02	0.01	....	100.03
	B	.08	....	....	90.54	.....	.....	9.33	....	.02	.01	....	99.98
4	A	9.31	.38	....	62.23	.45	4.52	23.00	....	.09	.02	0.15	100.15
	B	9.35	.41	....	62.37	.53	4.49	22.64	....	.08	.02	.15	100.04
5	A	4.97	.15	....	63.91	10.20	7.12	13.49	....	.18	....	....	100.02
	B	4.94	.15	....	63.91	10.22	7.13	13.43	....	.18	....	....	99.96
6	A	10.98	.23	.13	60.41	5.89	8.83	12.90	....	.72	....	....	100.09
	B	11.00	.24	.12	60.43	5.86	8.80	12.99	....	.71	....	....	100.15
7	A	5.98	....	....	71.42	.....	15.59	2.73	....	2.36	1.99	....	100.07
	B	6.02	....	....	71.37	.....	15.53	2.83	....	2.39	1.97	....	100.11
8	A	5.88	.03	....	65.76	5.73	10.02	10.60	0.61	1.35	....	....	99.88
	B	5.95	.03	....	65.89	5.70	10.16	10.87	.50	1.33	....	....	100.43
9	A	8.31	....	.18	83.31	.....	8.33	.....	....	.....	....	....	100.13
	B	8.39	....	....	83.29	.....	8.29	.....	....	.....	....	....	.....
10	A	9.67	.07	....	66.34	7.79	12.94	2.04	....	1.18	....	....	100.03
	B	9.65	.07	....	66.34	7.76	12.94	2.08	....	1.19	....	....	100.03
11	A	11.67	....	....	67.77	.....	10.55	10.13	....	.....	....	....	100.12
	B	11.65	....	....	67.80	.....	10.54	10.12	....	.....	....	....	100.11
12	A	.....	.....	....	75.61	.....	10.64	10.18	....	1.12	2.71	....	100.26
	B	.....	.....	....	75.63	.....	10.60	10.10	....	1.04	2.74	....	100.11
13	A	.22	.46	....	66.23	19.41	.23	13.31	....	.10	....	....	99.96
	B	.19	.50	....	66.27	19.46	.21	13.32	....	.14	....	....	100.09

XVIII. RESULTS OF ANALYSES OF A NUMBER OF ALLOYS

The results of 13 analyses made according to the methods described in this paper are given in *Table 7*. The analyses were made in duplicate and the composition of the alloy was reported as the average of the two determinations of each constituent giving the percentage to one decimal place, except when the amount of the constituent was less than 1 per cent, in which case the percentage was given to two decimal places. In the table all of the results are given to two decimal places for purposes of comparison only.

XIX. ACKNOWLEDGMENT

The author wishes to acknowledge his indebtedness to Dr. Edward Wichers, chemist at the Bureau of Standards, under whose direction this work was carried out, and who aided in the preparation of the manuscript for publication.

BACTERIA IN VITAL PULPS OF HUMAN TEETH[1]

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The widespread interest in focal infection that originates in septic teeth makes a study of any phase of that subject interesting to dentists. For several years, in research along this line, I have cultured, or have had cultured, microörganisms from six or seven hundred teeth. This work was started in my own laboratory in a rather superficial manner, as I had not then a definite conception of what I really wanted to learn and did not keep a definite record of all my first efforts. The research was started because I was interested in bacteriology and was exploring. I have been very much impressed by the similarity of the early results and of those obtained later, under the most careful and painstaking technique, when I desired to learn whether grinding enamel off a tooth allowed microörganisms to penetrate to the pulp.

At first I made cultures of all the extracted teeth I could get, without determining whether they were vital, but very soon learned to choose. However, it was interesting to note in passing that when the pulp was entirely broken down, some of the teeth, which apparently were the cause of discharge into the mouth through a sinus, did not yield any microörganisms from the pulp chamber. Possibly this was due to faulty technique, or the scrapings from the pulp chamber contained microörganisms which would not grow on our culture media—plain agar and blood serum. Culturing the first couple of hundred pulps of teeth, freshly extracted and known to be vital, we recovered micrroöganisms from practically every pulp or fragment of pulp. Noting these facts we became more careful in our technique, and the following improved method was used: After the tooth was extracted, we thoroughly wiped the surface of the tooth and root with 5 percent hydrochloric acid solution; with a stone, cut a groove longitudinally on

[1] Read at the fifth general meeting of the International Association for Dental Research, Hotel Plaza, New York City, April 19, 1927.

the root for the blade of the cutting forceps; and again sterilized the surface of the tooth and root with 5 percent hydrochloric acid. Then, after sterilizing the cutting forceps, the tooth was split into a sterilized tray under the cover of another sterilized tray; the pulp or parts of the pulp were removed with sterilized instruments, and placed in broth—later in sub-culture of the broth.

The results proved that 85 percent of the pulps contained microorganisms, principally of the streptococcus variety, although we frequently recovered Staphylococcus aureus. This result was so persistent and universal that I felt it would be wise to have some outside assistance and opinion. Therefore, I asked the Dental Research Committee of the University of Toronto for permission to have the cultures made under their auspices, which was done by their technician in the University laboratories.

I explained the manner of obtaining the material for culturing, which was pronounced satisfactory. To the Research Laboratory, we sent about thirty pulps, cultured in the way described above. About 85 percent contained microörganisms; that is, the results were about the same as those obtained in my laboratory. The microorganisms detected were Staphylococcus aureus and several strains of streptococcus. Notwithstanding the fact that the greatest care was taken to have the cultured material uncontaminated, the technician of the Research Committee, Miss Fraser, said of several cases that "this culture has been contaminated by the flora of the mouth." Her comment aroused our curiosity and interest, and we found that, when this report was given, it invariably referred to the pulp of a tooth which had a deep cavity. Consequently, we suspected that the microörganisms of the mouth traveled through the cavity into the pulp chamber, although so far as the eye could see there was no connection between the cavity and the pulp chamber. Miss Fraser's finding led us to believe that microörganisms travel readily through the dentin into the pulp, and I concluded that, when the enamel is ground off the dentin, there is established a passageway for the microörganisms of the mouth to the pulp and probably from the pulp into the general circulation. I also came to the conclusion that, when the enamel and cementum remain intact, microörganisms cannot travel from the mouth into the pulp.

In a report to the American Academy of Periodontology, I drew attention to the fact that, when a tooth is abraided by attrition or when a cavity is formed, secondary dentin is deposited in the pulp chamber. As demonstrated by Dr. Bödecker, this secondary dentin always blocks the canaliculi leading from the decay or abrasion to the pulp, and contains a hundredth part of the number of tubulii in normal dentin. But when a tooth is ground off by artificial means, there is no opportunity for such a defense to be constructed by nature. That argument seemed good then, and as far as I can see is sound. But the deduction that the pulp, if protected by a perfect covering of enamel and cementum (preserved in contact, and not broken by decay or otherwise) will not contain microörganisms, has not been borne out by our later experiments.

In order to ascertain whether a tooth, if perfectly covered by cementum and enamel, could have microörganisms in the pulp, I started a year or so ago a number of experiments in St. Michael's Hospital, Toronto. In a hospital of this kind a great many teeth are extracted, some of which are vital. The patient being sick and poor, either does not care to preserve his living teeth, or it is thought from one standpoint or another not advisable to save the living teeth. I chose only teeth which were undoubtedly vital, and which had not a break in the enamel or cementum so far as we could find. Of course this means that the number obtained for our experiments was necessarily small. However we obtained thirty-four specimens. I was astonished to find that 65 percent of these teeth contained microörganisms. Consequently, the theory that perfect teeth do not contain microörganisms, and that bacteria enter the pulp only when enamel is ground off, or through cavities, or by way of pockets, was not borne out by the investigation.

In doing this work we had to conform to the rules of the Pathological Laboratory of the Hospital. The person who splits the teeth and does the culturing must wear a gown, sterile gloves, a mask and cap; and the teeth, before being split open, must be covered with alcohol and that alcohol burnt off, at least three times. Of course we were glad to live up to the regulations of the laboratory. Dr. Rutherford, head of the dental clinic, was good enough to take part in the work, and to give it his entire support and assistance. Drs.

Frawley and Montgomery also coöperated. As the cultures were prepared under the direction and personal supervision of William Magner, M.D., F.A.C.P., D.P.H., the pathologist of St. Michael's Hospital, there is scarcely any chance that a mistake was made.

We have not desired or asked for a minute segregation of the different strains of organisms found, but in some cases very interesting information has been obtained. The organism usually found is Streptococcus viridans, and in about one third of the cases Staphylococcus aureus; but, in one case, extraordinary as it may appear, we found Bacillus coli communis. This was in a patient from whom an appendiceal abscess had been removed two weeks before we made the culture. In this case the bacillus, evidently from the appendiceal abscess, was still in the circulation, or, having entered the tooth from the circulation, had been preserved and protected in the pulp. Would one not be justified in concluding, as a result of the foregoing, that the source of selective organisms in septic areas surrounding and in roots of teeth may be a long distance from the teeth? In other words, the teeth may not be the original focus of infection. Although I started this work in periodontia, it raises questions relating to focal infection in and around the teeth. It also suggests that a devitalized tooth may not do harm to the individual, but that a vital tooth may be a definite source of infection.

There are many lessons to be learned from these investigations. In the first place it seems to be a dangerous thing to grind the teeth with stones until the dentin is exposed. To treat exposed dentin with sulphuric acid would make it much more dangerous, because the contents of the tubulii would be dissolved, leaving a perfect receptacle for microörganisms other than those already found in the pulp. But, on the other hand, some teeth, extracted because they are loose or have deep pockets around them, do not need to be extracted because of infection, since they do not contain microörganisms. In teeth having a great amount of secondary dentin in the pulp chamber—in other words, where the pulp has been partly or almost entirely obliterated—there were no microörganisms, provided there was some vitality in the pulp. This was true of a number of teeth from which the periodontal tissues had been stripped for over half the length of the root, and of teeth which had become calcified to such an extent that the apical

third of the root was transparent. Another peculiar fact was the discovery that in many instances, where we extracted two apparently perfect teeth in the same mouth under the same conditions so far as we could see, one contained microörganisms and the other was sterile. We also found that in some cases the patient gave a history of having no constitutional trouble, and yet there were microörganisms in the pulps of the teeth.

We had sufficient cases to show that it is not necessary for the patient to have had recent illness for microörganisms to occur in the pulps of teeth, nor is it necessary to have a deep pocket, or, so far as one can see, infection at the gingival margin; I say so far as one can see, because from the experiments of Drs. Simmons and Hartzell, and others, it is difficult to say that there are no microörganisms in the tissue of the gingivae.

The number of perfect teeth employed was small. But one should not lose sight of the fact that embodied in this paper are reports also of hundreds of other teeth, many of which had but small cavities, and some only stains. Which means that perhaps we have really been too careful in selecting our material for the latter part of this report, unless we take it for granted that any small cavity would be a possible passageway for microörganisms to the pulp. I do not believe that that would be a proper deduction from our results, nor do I believe that judicious grinding of the enamel in the hands of an experienced operator is fraught with any danger to the patient.

Let me draw your attention to another fact which has been disclosed; namely, that the percentage of perfect teeth containing microorganisms, in such work as this, will be very greatly influenced by the kind of teeth chosen. That is to say, if teeth extracted on account of chronic alveoloclasia are taken, there will be a very low percentage containing microörganisms. On the other hand, if the selected teeth contain fairly large functioning pulps, the percentage will be high. I have no doubt the physical condition of the patient also has a very great influence on the percentage.

The Toronto Section brought to you, last year, a record of the efficiency of copper amalgam as a root filling. Connect that with this investigation and we have the possibility of eliminating the focal infections that originate in devitalized teeth.

(The author presented specimens of the reports and history charts used in the hospital, and indicated intention to check the work by x-ray and blood-culture methods.—*Ed.*)

2 Bloor Street, East.

PORCELAIN JACKETS UNDER STRESS[1]

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My paper tonight will treat of porcelain jacket crowns under stress of mastication. I will try to show that a properly prepared tooth with a properly baked porcelain jacket will stand up under ordinary mastication. I think that the best way to present this subject is to treat it in several divisions. First, I will review some of the work of Dr. G. V. Black, whom all of us will acknowledge as probably the greatest of all dental scientists. We will study the results of his work (a) on the force used in mastication, with relation to the strength and health of the peridental membranes; and (b) on the force required in the mastication of food. I will then compare his results on human teeth with some of my own results with porcelain jackets.

I

Force used in mastication in relation to the strength and health of the peridental membrane

In 1893 G. V. Black began an inquiry on the force used in mastication, and in 1895 published results in *Dental Cosmos*. The force of the bite, or the pounds-force with which the jaws may be closed upon any object, varies greatly among different persons, and is dependent in a larger degree upon the conditions of the peridental membranes, and upon personal habits in the use of the teeth in mastication, than upon masticatory power. In a tabulation of the results in 1000 persons, the average force exerted was 171 pounds per square inch of exposed grinding surface on the molars, and very considerably less on bicuspids and incisors. The variation was from 25 to 275 pounds. The instrument used in testing the force was a gnatho-dynamometer.

[1] Read at a meeting of the Harriet Newell Lowell Society for Dental Research, Harvard Dental School, May 20, 1927.

In using this instrument, error may occur from biting very close to the rubber pads, or from catching too far from the ends, which together may produce an error of about 10 per cent. With this exception, the instrument is as accurate as any spring scales. In these trials, the instrument generally rests upon two teeth in one jaw and upon one tooth in the other. Occasionally it can be so placed as to rest fairly on two teeth in each jaw. The force of the bite of any individual is modified very materially (a) by the use habitually made of the teeth, (b) by the loss of the pulp, and (c) by disease of the peridental membranes.

Nearly everyone using the gnatho-dynamometer stops the test because of pain in the peridental membranes, and not because of having reached full muscular effort. Therefore, modification of these peridental membrane conditions is prominently brought about. Full and free use of the teeth in mastication, and especially the disposition to use them freely on hard foods, contribute to strength. Any considerable limitation of the use of the teeth, even for a few days, shows in tenderness of the peridental membranes; and in cases where the patient has fallen into the habit of swallowing food practically without mastication, the power of the bite may be as low as 50 lbs. or less. Incidentally I think this may give us a clue as to why a tooth sometimes hurts from apparently no cause after we place a large restoration, jacket crown, or what-not. In disease affecting the peridental membranes, the power of the occlusion is rapidly reduced; that is, the muscles of mastication are held from exerting full power by pain warning them to go no further. A tooth from which the pulp has been removed seems never to recover completely.

The limitation of the force of the occlusion, as shown by the gnatho-dynamometer, is therefore a register of the power of resistance in the peridental membranes and not of possible muscular exertion. The strength of the teeth is ample for all stress that is brought against them, provided very hard substances are excluded, such as hard metals, pebbles, etc. This is made clear by trials of the strength of freshly extracted teeth. These were cut squarely off at the junction of the middle and gingival thirds of the crown so that the occlusal portion would stand solidly on a flat piece of steel arranged in a registering dynamometer.

Results of tests with hard steel directly applied to teeth[2]

1. A mesio-buccal cusp of an upper second molar; a fairly sharp cusp. A portion of the enamel of the buccal portion of the cusp split away at 125.

2. A rather obtuse lingual cusp of the same tooth. The enamel checked but was unbroken at 350.

3. A disto-buccal cusp of an upper second molar; rather sharp. The enamel began to check at 135, and a part of the cusp split off at 165.

4. A well rounded lingual cusp of an upper bicuspid. A check in the enamel began to show at 100, but no further break occurred at 350. On removing the tooth, the enamel was found to be disintegrated over a small area where the steel had been applied.

5. A sharp buccal cusp of an upper first bicuspid. A check in the enamel began to show at 125, and the buccal portion of the enamel split off at 150.

6. The disto-lingual cusp of a lower first molar; the mesial portion had been destroyed by caries. A check in the enamel began at 115, and the cusp crushed at 150.

7. A sharp disto-buccal cusp of a lower second molar. A check began at 100, and a part of the enamel split off at 140.

8. A lingual cusp of an upper third molar. A check was seen at 100, and a part of the enamel chipped away at 140.

Tests with vulcanized rubber, 3/32 inch, between the steel and the cusp of the teeth[2]

9. A fairly sharp buccal cusp of an upper first bicuspid. No injury at 350, but the rubber was nearly cut through.

10. A sharp mesio-buccal cusp of an upper second molar. No check appeared up to 325. At 335 the rubber suddenly parted, letting the steel come upon the tooth and the cusp was split off.

11. The cusp of a cuspid. No injury at 350.

12. The edge of a central incisor. No injury up to 240, at which point the rubber was suddenly cut, allowing the steel to come into contact and crush the tooth.

[2] The figures in this section refer to number of pounds.

These few cases show the strength of the teeth as well as many more cases would. A hard substance like tempered steel, bitten upon with full force, is liable to check the enamel or split off a cusp, for the reason that, with the sharply rounded surface of a cusp, the full pressure is concentrated on a very small area of the enamel. But whenever this force is distributed to a larger surface, as is done by a cusp sinking into hard rubber, no harm is done by even a greater force than is ever used in chewing food.

Force required in the mastication of food

Our mode of preparing foods has had a tendency to render them softer and softer. This is probably a blessing to the wearers of some of our full and partial dentures. The following data, from trials published in *Dental Cosmos* in 1895, show the force required for the crushing of meats. The instrument used was the phago-dynamometer, and the work was done by Dr. Black:

	Pounds
Boiled corned beef, nice and tender	30–35
Beef steak, medium, chuck	40–60
Beef steak, well done, chuck	45–60
Beef steak, rare, tenderloin	35–40
Beef steak, round	40–50
Beef steak, well done, rather tough	60–80
Mutton chops	30–40
Mutton steak	35–45
Roast veal, tender and nice	35–40
Roast loin of veal	30–35
Roast beef	45–60
Roast beef loin	35–50
Pork loin chops	20–25
Roast pork	30–35
Broiled ham, nice and tender	40–60
Cold boiled tongue, central part	3–5
Cold boiled tongue, near root	15–20

These tests were made with meats placed on sale within two hours after killing and were generally used the same day. This was the

custom in most of the smaller cities until it was supplanted by the use of cold-storage meats prepared by the great packing houses, which have now almost universally taken the place of the local butchers. These meats are crushed at from one-fourth to one-third less pressure than fresh meats, and are sometimes even softer than these figures indicate. The following results were obtained with candy:

	Pounds
Crystals of rock candy	30–35
Lemon tablets	50–70
Hard candy-stick, old	90–120
Hard candy, stick, fresh	45–60
Small cinnamon drops	30–60

II

I will refer often to a "properly handled porcelain" or a "properly baked porcelain." By this I mean a porcelain jacket built up fairly rapidly, thoroughly condensed, kept free from foreign bodies, inserted in a cold or cool furnace—the temperature brought up very slowly to within 25° or 50° of the glazing point on the first bake, and one which is glazed on the second bake by handling the porcelain in the same manner. I find that a porcelain jacket cooled in the furnace is slightly stronger than one cooled in the air. This is probably due to some molecular rearrangement, as in heat-treated metals. In my experimental work, I used duplicate specimens of porcelain jackets made, for various patients, with Justi High-Fusing Porcelain baked in a Barkmeyer furnace.

I took several jackets and packed amalgam dies into them. These dies were ground flat at the free end, and placed in a dynamometer with the occlusal surface of the jacket and the flatbase of the amalgam die both touching the bare metal. I obtained the following results, which should be compared with Black's figures:

Black's data for force required in mastication of food

	Pounds
1. Average masticatory force	171
2. Average force to crush meat	35–40
3. Average force to crush hard candy	65
4. Average strength of tooth against steel	157

Porcelain jackets against steel[3]

1. Upper lateral, with fairly good shoulder. Crushed at 101.

2. Same tooth, with no shoulder. Checked at 2. The whole thing gave way at 129. The porcelain alone crushed at 83, and the amalgam alone crushed at 155.

3. Upper bicuspid, with no shoulder. Crushed at 40. Another one crushed at 50.

4. Same tooth, with a shoulder. Crushed at 152. Another at 250.

5. Upper central, with no shoulder. Crushed at 30.

6. Same tooth, with a shoulder. Crushed at 114, with the amalgam still holding.

7. Upper cuspid, with no shoulder. Crushed at 17.

8. Same tooth, with a shoulder. Crushed at 75; another at 92. Neither of these had a very good shoulder.

9. Upper molar, with no shoulder. Crushed at 30.

10. Same tooth, with a shoulder. Crushed at 220.

This gives us an average of 142 for jackets, with the average shoulder as prepared by practical men. We get an average of 28 for jackets without a shoulder.

Next, I cemented several jackets to amalgam dies, and tested them with the following results:

11. A lateral incisor with a pin instead of a gold core, having a wide but very uneven floor. Checked at 40, and crushed at 172.

12. A bicuspid, with no shoulder, was crushed at 27.

13. A molar, with a fair shoulder, at 197.

14. A cuspid, with a good shoulder, at 176.

15. A molar, with a fair shoulder, at 199.

16. A molar, with no shoulder, at 115.

17. A central, with a good shoulder, at 65.

18. A cuspid, with a good shoulder, at 173.

19. A bicuspid, with no shoulder, was crushed in two places at 170.

20. A bicuspid, with a wide but even shoulder, at 170.

21. A molar, with a fair shoulder, at 191.

This gives an average of 162 for those with a fair or good shoulder.

Next, three jackets, baked by students at this School, were tested.

[3] The figures in this section refer to number of pounds.

These were also made with Justi High Fusing Porcelain. I got the following results:

22. Cuspid, technique case, good shoulder, four times in the furnace. Crushed at 60.

23. Cuspid, technique case, good shoulder, three times in the furnace. Checked at 25, and crushed at 62.

24. Central, practical case, good shoulder, five bakes (four bakes of 7–8 minutes after 1945°). Glazed for 18 minutes after 1945°. Taken out of furnace four or five times to see if it was glazed on final bake. Crushed at 25.

These results show the necessity for correct handling of the porcelain.

Conclusions regarding the porcelain work

1. A good, clean-cut, well-defined shoulder is absolutely essential for strength in a crown.

2. The skill with which the porcelain is handled in the baking governs the strength to a large degree.

3. Porcelain jackets properly baked will stand up under more pressure than is ever used during mastication, provided the tooth itself is properly prepared.

4. A well baked porcelain jacket on a well prepared tooth is practically as strong as a normal tooth.

5. Poorly baked porcelain, on a tooth with a good shoulder, is only as strong as well baked porcelain on a tooth without a shoulder.

THE ROOTS OF DENTAL SCIENCE[1]

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INTRODUCTION

When we first took up the study of dentistry, in the enthusiasm of youth, we grasped eagerly at the statements of our textbooks and instructors and held them as certainties, principles, facts. But in the ensuing years we found that an inevitable whittling down took place. Facts had melted out of shape, principles had failed on application, certainties came to appear uncommonly like opinions. Wisdom and truth are slow of attainment. Leonardo da Vinci (1452–1509) was wont to say: "Wisdom is the daughter of experience; truth is the daughter of time." Every man of experience comes to feel some dissatisfaction with the state of his practice, some doubts and misgivings concerning the science underlying it. These dissatisfactions, doubts, and misgivings do not discourage us, but merely spur us on to greater effort, to the accumulation of wisdom and the quest of truth. For, as Herman Melville wrote a hundred years ago, "faith, like a jackal, feeds among the tombs and from these dead doubts gathers her most vital hope." From your presence I gather you are willing, sharing a common feeling, to hear sympathetically

[1] Read at a meeting of the First District Dental Society of the State of New York, New York Academy of Medicine, February 1, 1926.

this account of my delving among the roots of dental science and the suggestions which are the fruit of that cultivation.

Lawyers and physicians, said Plato (427–347 B.C.), are an ill provision for any country. Montaigne (1533–1592) amplified and explained this, saying: "For in sowing and retailing of questions they make the world to fructify and abound in uncertainty. Learning breeds difficulty, as the ground, the more it is crumbled, broken, and deeply removed or grubbed up, becometh so much more fertile" (1).

HISTORY OF AMERICAN DENTISTRY

My colleague, Dr. F. C. Waite, has written a fascinating brief history of dentistry in the United States. With this as a background, we can more readily understand just why dentistry occupies its relatively isolated position in the medical group to-day. In none of the medical schools of this country flourishing before 1837 were there any courses in dentistry. Tooth extraction was a mere incident of medical practice, and mechanical dentistry was learned by apprenticeship to an artisan. Nevertheless, there were occasional physicians who did so much dentistry that they might be considered dentists. But it was to the jewelers and silversmiths, the carvers in wood and ivory, that we owe the replacement dentistry of the eighteenth and early nineteenth centuries in America. "The origin of the dental profession in the United States was individualistic, not generic. These two trickling streams of early American dentistry came from two sources—one professional, the other artisan" (2).

In 1837–38 the University of Maryland conducted a course in dentistry, and in the following year more extensive instruction in dentistry was proposed, but the suggestion was rejected on the ground that dentistry was not of sufficient importance. The Baltimore Dental School was then started as an independent proprietary institution. In consequence of the failure of the University of Maryland to continue to promote dental education, dental schools established the thesis that medical training, *i.e.*, the full course of training leading to the M.D. degree, was unnecessary for dentists. And for many years the dental and medical professions drifted steadily apart with the result that dentistry became more and more technical in character. So thoroughly maimed was dentistry at its very birth, in this country,

that the establishment of a dental school at Harvard University in 1867, and increasing coöperation with medicine later, have not sufficed to restore balanced development to dental practice. As Doctor Waite writes: "What had started as a specialized profession became a craftsmanship." But, after all, the history of dentistry in all countries indicates that it has largely tended towards craftsmanship (9).

Time does not permit us to follow the mushroom-like growth of proprietary dental schools between 1880 and 1900, nor to review the independent efforts of the National Association of Dental Faculties established in 1884, and of the Association of Medical Colleges established in 1891, to improve the educational relations of the two professions. Unfortunately, there has been no real coöperative effort up to the present day.

This, then, is the background for our study of dentistry in America. Let us, however, put this aside for a time in the contemplation of our common heritage, for, of course, the history of dentistry is closely associated with that of medicine, as their interests are indivisible, in spite of fissures which misfortunes have imprinted upon the surface.

WHITE MAGIC

There is a popular understanding that in its early history, medicine was one with magic. Yet this is not so. As far as history informs us, the origin of medicine dates back to Hippocrates of Cos, when it apparently developed suddenly as an art in the fifth century B.C. At this early time there were also priests of the cult of Aesculapius practising healing at the health temples. This healing was carried out by "white magic"—the laying on of hands and the reciting of incantations. The health temples were institutions dating far back into antiquity and centered on the main one at Epidaurus, the home of the God Aesculapius. No one is ever described as going to an Aesclepion to benefit by change of air or for the cure of a disease amenable to the art of medicine, "any more than," as Withington remarks, "a Catholic would go to Lourdes for the climate or to have a tooth filled," (3). They all hoped, if highly favored, to get immediate advice in a dream. The temples apparently did not care for patients who were bed-ridden; they could almost all walk.

At Epidaurus there have been found certain pillars on which the record of cases is inscribed. The first is that of Cleo. This lady was said to have been delivered of a five-year old boy who "promptly washed himself and walked about with his mother." There is the record of another interesting case. "A woman had a worm, and the ablest physicians gave up curing her. So she went to Epidaurus and besought the God for deliverance from the domestic plague. The God was not there, but the attendants made the patient lie down where the God is wont to heal the suppliants, and she went to rest as directed. But they, in the absence of the god, began her treatment and cut off her head. Then another put his hand down and took out the worm, a great thing of a beast; but they were no longer able to put the head back and fit it accurately to the old joining. Then the god came and was angry with them for undertaking a task beyond their wisdom, but he himself, by power invincible and divine, put the head back on the trunk and raised up the guest."

There is now much evidence to show that the ancients did not confuse the human art of medicine with prayers, divination, and the like. Thucydides indeed mentions them both specifically as useless during the plague at Athens (428 B.C.). "If there was a therapeutic dream oracle at Cos in the fifth century, B.C., the Hippocratic writers will have nothing to do with it, they will not even mention it. Where medicine is concerned, the god disappears. Instead of the priest, comes the physician; instead of the dream oracle, science; instead of Aesculapius, the Asclepiad, or travelling physician (3).

Much has been made of Egyptian medicine. It has been assumed from altogether too slender evidence that medicine was a highly cultivated art in the New Empire about 1500 B.C. I have attempted to show that this view is unsupported by any adequate data, that Egyptian medicine was really white magic, a matter of incantations eked out by doses of weird mixtures of roots and refuse, and that the so-called specialization of medicine in Egypt was not more than the diversification of magical cults (4). Nor indeed could it be otherwise, for the human art of medicine had not developed at that early date. The so-called surgical operations, except those of opening an abscess, possibly some operations on the eye, and the ritual of circumcision, were no operations at all, but ceremonies like those described

in the fourteenth chapter of Leviticus. Further, much of the so-called specialization is figurative language. The assertion that any dentistry other than extraction was practiced in Egypt is open to question (5).

To Aristotle, who was tutor to Alexander the Great (356–323 B.C.), were attributed, in mediaeval times, numerous spurious writings. Of these, one entitled "The Secret of Secrets" was a manual of personal hygiene and practical philosophy essential for Alexander to know. The abdomen must be kept warm and the bowels moving regularly; turkish baths; mouth and teeth to be kept clean; eating to cease while appetite still remains (6, II, 273). But even this keeping clean of the teeth was figurative. We read in Amos IV, 6: "I have also given you cleanness of teeth in all your cities and want of bread in all your places; yet have ye not returned to me, saith the Lord."

All ancient medicine as far as the fifth century B.C. was really white (or beneficent) magic. Since that time the human art of medicine and the priestly cult of white magic have frequently been confounded, usually by laymen, but often within the profession itself. The true art of medicine claims no supernatural aid or inspired knowledge, but "clearly has and ever will have its essence in causation and the power of foretelling" (3), that is, in prognosis. But of course dreams also have as their function forecasting of the future. Vincent of Beauvais "of the order of preachers," in 1246 A.D. was subprior of the Dominican Monastery at Beauvais. He was librarian, chaplain to Louis IX (Saint Louis), and tutor of the King's children (6, II, 458). In the "Mirror of Nature," Vincent wrote that dreams are not causes but signs of the future. To see a foul mouth in a dream indicated a false criminal accusation. It is easy to see how confusion would arise between the prognosis of medicine and the forecasting by dreams. Yet there have been writers throughout the Christian era who have protested against this confusion.

Moses Maimonides, the "Israelite of Cordova" (1135–1204), was with his father driven from Spain in 1160 and became physician to the vizier of Saladin. In 1190 he wrote the "Guide for the Perplexed," and in 1198 a treatise on poisons for the Cadi Fadhil. In the Guide, Maimonides discusses the three features of magic:

(1) The materials: properties of plants, animals and metals.
(2) The times: when these should be employed.

(3) The rites: gesticulations, actions, cries, and incantations of the human operator.

These may be all combined in a single operation, e.g., the plucking of an herb at a special phase of the moon. Now, to the common mind, this is indistinguishable from the gathering of foxglove leaves at a certain period of growth of the plant, a precaution quite essential if we are to get the maximum of active principle out of the leaves.

"Everything is licit," says this writer, "in which any natural cause appears." The use in suspension of a nail from the yoke of criminals or the tooth of a fox was allowed, "for in these times they placed faith in these things because they were confirmed by experience and served in the place of medicine." Even yet, we have to admit the use of digitalis in heart conditions, or nux vomica and belladonna for constipation, to be without adequate scientific explanation. Nevertheless, their use is accepted in modern medical practice. In actual practice medicine and white magic seem often very closely related. When you pass an electric current through a piece of wire and submerge it in a tray containing carbolic acid, these operations being done in an expensive piece of apparatus instead of passing the wire through the flame of a bunsen burner, are you practising scientific dentistry or white magic?

The suspension of a peony from the patient's neck in epilepsy, or dog's dung against pustules or sore throat, was held justified "for whatever is proved by experience to be true, although no natural cause be apparent, its use is permitted because it acts as a medicine" (6, II, 205). When I was a child there was still extant, among the more ignorant Scottish people, a cure for sore throat in the wrapping round the neck at bedtime of a stocking worn by a domestic servant for two weeks! What I want you to notice is that white magic is still practised extensively all around us and sometimes I think by ourselves. Often clear sighted persons have employed different methods to combat the insidious spread of white magic. Lucian (120?–200 A.D.), the satirist, ridicules it in the following way: "For gout," he says, "take in the left hand the tooth of a field mouse (the smallest of living mammals) killed in a prescribed manner; wrap it in the skin of a lion freshly flayed, and bind it about the ailing foot, when relief will come instantly!"

Teeth have always figured largely in white magic, and some of the prescriptions are still employed even though their meaning is forgotten. Albertus Magnus (1200?–1280), Bishop of Ratisbon, recommends that a lion's canine tooth be suspended about a boy's neck before he loses his first teeth: this will free him from toothache when his second teeth come. Dog's teeth suspended from the neck cure jaundice. Dogs will not bark at one who holds in his hand the tooth of a black dog, "and so robbers carry such a tooth with them at night." Culling a few more of these extraordinary methods from the records of mediaeval days we find that heliotrope, plucked when the sun is in Leo in August, and worn wrapped in a laurel leaf with the tooth of a wolf, insures that the wearer shall be addressed with none but friendly words. A man's tooth and a hoopoe's wing suspended over a sleeper will prevent awakening until they are removed. Take the teeth, nose, and bones of a dead man and sit under a tree, when it will incline towards you. The pulverized tooth of a dead man protects a newly married couple against witchcraft.

Some of these superstitions are very old. Pliny (100 A.D.) tells us that powdered tooth is efficacious against the stings of scorpions and bites of snakes. A woman may avoid gynecological disorders by constantly wearing in a bracelet the first tooth her son loses, provided it has not touched the ground. There is such a bracelet on the wrist of many women to-day. Serpents (the evil avatars of godhead) flee from a man who wears the tooth of a deer. (Loyal Order of Moose please copy!) Dioscorides (2nd century A.D.) informs us that an amulet of teeth from a mad dog will protect the wearer from being bitten by one. This is an ancient version of a "hair of the dog that bit him." Perhaps the finest of all the white magic of mediaeval times is the statement that, if a man has struck another in anger, he may remove all resentment on the part of the victim by spitting into the hand which dealt the blow. This precious philosopher goes on to to add that, if the hand be spit into before the encounter, the blow will surely be more shrewd!

For toothache there are many remedies. Pliny recommends injection, into the ear nearer the tooth, of the ashes from the head of a mad dog mixed with oil of Cyprus. And later, asparagus was attributed to him as a sure cure. Again an aching tooth should be scarified

with the left upper canine of a dog. It will also be healed if certain roots be dug up with iron and the patient thrice alternately touches the tooth with said roots and spits, then replaces the roots in the same place and they live. Galen (100 A.D.) deplores that brain of a hare is only fairly good for boy's teeth. Albertus Magnus (1200?–1280) would hang parsley round the neck for toothache. Peter of Spain (1210?–1277) suggests touching the ailing tooth with that of a dead man, holding in the mouth violets cooked in wine, or a grain of opium between the teeth (notice the confusion of magic and medicine), deer horn burned till it whitens (ammonia), or a powder made from dog's teeth.

For carious teeth Hildegard of Bingen (1098–1180) recommends pulverized salmon bones. Peter of Spain would fill the cavities with partridge brain or crow's dung, which "breaks the tooth and removes pain." Marcellus recommends standing under the open sky and spitting into a frog's mouth, or repeating argidam, margidam, sturgidam, seven times on Tuesday and Thursday in a waning moon. Who wants to wait for a slow cure like that! Galen recommends a cooked black chameleon, or a frog boiled in vinegar and water, or better still, filling the cavities with toasted earthworms or spider's eggs diluted with ointment of nard.

To facilitate extraction of teeth Galen would scrape the tooth thoroughly, or cut the gum loose about it and sprinkle with ashes of earthworms. Further, he suggests that an upper tooth should be surrounded with the worms found in the tops of cabbage leaves; a lower tooth with those worms found feeding on the lower parts of the leaves.

Usually in the twelfth century the incantations are cast in Christian form, but one for toothache has slipped by, at least partially uncensored, "O Lady Moon free me . . . ." (6).

So much then for white magic. Grotesque as it appears in the examples given, today neither ordinary life, nor religion, nor medicine, nor dentistry, is quite free from it.

I have pointed out how American dentistry, from the circumstances of its inception and early history, has tended towards craftsmanship rather than towards science. And I have indicated how thoroughly

infected we still are by magic. Man is an illogical being and, as Lascelles Abercrombie recently wrote, "our glimpses into the Empyrean are usually connected with the common nonsense of life. We grow confused in our experience and, without much thought, wrongly evaluate the phenomena of our daily life." My friend, Dr. Dittrick, drew my attention the other day to Lady Gregory's quotation of the saying in Irish: "An old woman without learning, it is she will be doing charms." Of Biddy Early, she states that twenty or thirty people would be there in a day looking for cures and everyone of them would bring a bottle of whiskey. Biddy had four or five husbands who all died of drink one after the other. "The priests they were greatly against Biddy, and there is no doubt it was from the faeries she got the knowledge. But who wouldn't go to hell for a cure if one of his own was sick? And the priests don't like to be doing cures themselves. Father Flynn said to me, 'If I do them I let the devil into me.' But there was Father Casey used to do them, but he went wrong with the people bringing too much whiskey and Father Mahoney had him stopped."

RIGOROUS THINKING

This brings me to my third and final theme. Recently I was reading Keyser's "Human Worth of Rigorous Thinking" (7). In this excellent essay the author reminds his readers that "much of what passes in the world for successful action proceeds from impulse or instinct, and not from thinking of any kind; you should know that no action under the control of non-rigorous thinking can be strictly successful except by the favor of chance or through accidental compensation of errors; you should know that most of what passes for successful action—so far from being really successful—varies from partial failure to failure that, if not total, would at all events be fatal in any universe that had the economic decency to forbid, under pain of death, the unlimited wasting of its resources. The dominant creature of such a universe would be, in fact, a superman. In our world the natural resources of life are superabundant, and man is poor in reason because he has been the prodigal son of a too opulent mother." Rigorous thinking is the first essential in any scientific work. And yet so curious a creature is man and so tortuous his thought that we are

entangled hopelessly in the net of our own making, as Montaigne said of the law. "She doth but quest and ferret and unceasingly goeth turning, winding, bilding and entangling her selfe in hir owne worke; as doe our silk wormes, and therein stifleth hir selfe."

Perhaps there is nothing in science so vigorously discussed, and so notable for schools of teaching, as the method of action of the human jaws. The subject has indeed almost become a matter of cults. To mention it is to portray in a sentence the dangers and difficulties of our present efforts at rigorous thinking. For we have with us a definite tradition and rules for thought. As Schiller (8) defined it a few years ago: "It will seem self-evident that sound thought must play for safety and endeavor to proceed by *valid* steps to an *assured* conclusion. It will eschew, therefore, or minimize so far as may be, risks and hazardous guesswork; it will admire and revere formulae and forms, which, it will fondly believe, cannot go wrong, but assure success, like spells, to those who have mastered them. Hence, the perennial charm of formulae. They function as 'words of power;' to pronounce them is deemed enough to flood with light the obscurest problem; to rehearse them, like magic charms, seems essential and sufficient for salvation." This, I think is the deepest rooted and most insidious white magic of to-day.

We search out facts. But what are facts? They are merely the facts-as-they-seem-to-us. They are not immutable. They must be relative to the theories and principles of science as it finds itself at that particular moment. The facts of the physiologist are notoriously subject to modification. "Anything may be feigned if it is not found, and taken as fact hypothetically, and there is no hard and fast line to be drawn between hypothesis and fact, because the conclusions of hypothesis consolidate into 'facts' when they are sufficiently confirmed, and may then themselves form the basis for further hypotheses." Verification can never be absolute proof. One cannot argue that a hypothesis is true because the facts which follow from it have been observed, for these facts and other facts may well fit still better a hypothesis yet unformed. To say that no other hypothesis will fit the facts is only to inspire the formulation of still other hypotheses. And surely this is what has happened in the discussion of the movement of the human jaws. We must learn to acknowledge frankly

that all observations are esssentially inaccurate because of the human and therefore inaccurate standards on which they have been based. We must also boldly face the necessity of taking risks. Whewell says: "Advances in knowledge are not commonly made without the previous exercise of boldness and license in guessing. It is a barren caution which hopes for truth without daring to venture upon the quest for it, for it does not even gain its end, the escape from hypothesis."

Facts are the greatest stumbling blocks of science: they form a slippery foothold and give a false sense of security, for they are merely the facts-as-they-seem-to-be, and further investigation may explode them as the atom has been exploded at the very moment when it seemed to be established as a fact. "It is a dull and stupid mind," said Kant, "which divides in order to differentiate." And this is true of science as of philosophy. We must not demand absolute certainty, knowing that all we may have or need is certainty enough to live by. Hence, there is no need to be discouraged by the difficulties of investigation or to be cast down by its interminably slow approach to the goal, or to seek relief in blind suppression of doubts.

DEDUCTIONS

Now how can we apply to the improvement of dentistry the thoughts of the foregoing essay. We have seen that its early history has aligned American dentistry with craftsmanship rather than with science. It is probably too late to demand that dentistry return to the fold. It has fought its "Revolutionary War" and won. Nevertheless, the closest coöperative working out of a common destiny with medicine is dentistry's only hope. The Indians have a saying that "a man who knows only one branch of his profession is like a bird with but one wing."

Its very origin has rendered American dentistry weak before the insidious attacks of white magic, and only by rigorous thinking can these attacks be warded off. And rigorous thinking itself must be bolder and freer from tradition than ever it has been. I was asked the other day to give an address on practical cephalometry for orthodontists. But how am I to do this? As yet we know nothing of the principles of formation of the skull. The "facts" of skull formation

are the slipperiest of all facts-as-they-seem-to-be. Dentistry will do well to endow and maintain and align itself with institutions for the investigation of the basic principles upon which our practice is founded, realizing that even those principles are protean things, changing out of all recognition the more they are handled. And above all we must ever keep in mind the sentence which Leonardo da Vinci committed to his memoranda in the fifteenth century: "God sells us everything good at the price of fatigue."

SUMMARY

A study of the history of dentistry shows, first, that it has tended toward craftsmanship rather than science; secondly, that, in common with medicine and religion, it is honeycombed with white magic even to-day; and thirdly, that it is in need of the rigorous thinking which has no fears of hypotheses and is wise enough not to bind itself to so-called facts.

The lessons of this study are obvious corollaries to the findings.

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DISCUSSION

Holmes C. Jackson, Ph.D. (New York City): I appreciate the honor of being invited to hear and to discuss Dr. Todd's paper. I am sorry there were not more of my medical friends here this evening to hear his address, because it applies equally to medicine and dentistry.

For several years I have been interested in medical education, holding a

position in one of the medical schools of this city, and now have a similar position in a dental school. I have reversed the relation of Dr. Todd, being neither an M.D. nor a D.D.S. I am in the medical profession, but not of it. I have been on the outside looking in; and, having seen the wheels go round with considerable detail, have been able to get a certain perspective, which is not always possible when one is inside. Consequently I have seen, I think, that there is much white magic in medicine; and I may say, quite frankly, that there is a great deal of it in dentistry also.

This paper is a very difficult one to discuss. It is rather interesting to learn why it is that teeth play such an important part in white magic. Fraser, in his great book, "The Golden Bough," intimates that the early ideas that were associated with white magic were based upon the assumption that, if an individual carried with him a part of an animal, that part conferred upon him all the characteristics and potential talents of the animal. From that I think it was assumed that, as they recognized that the teeth were an important part of the armamentarium of the animal, the man who carried an animal's teeth was thus aided in his combats.

What interested me particularly was a point that Dr. Todd mentioned frequently—the matter of experience. That is the bugbear of the science teacher. After he has taken particular pains to get the student to attempt rigorous thinking, along comes the teacher who says that this or that is his *clinical experience*—and quite often clinical experience and scientific teaching do not agree. That is nothing against either of them, but it is well for us to examine what experience really means. If wisdom is the daughter of experience—and by that I suppose we mean truth—or if we are to determine facts through experience, we should understand the import of experience, and comprehend the fallacies that may affect its interpretation.

One particular phase of experience is that of causal relationship—the relation between cause and result, particularly as applied to medicine and to therapeutics or treatment, as for instance in dental practice, where you do a certain thing, and get a certain result. That soon becomes experience, so-called. There are fallacies in the development of such experiences. We have the Latin quotation, "post hoc ergo propter hoc," meaning if two events occur in sequence, they are necessarily in causal relationship, and one is the cause and the other is the effect. Cause A might bring about result C. If it occurred in 100 per cent of cases, you might say it was a causal relationship, but it does not occur in this percentage in dentistry any more than in medicine. If you have it in only 50 per cent of cases, why does it not produce the result in the other 50 per cent? Why

does A produce C? It might be that A causes B, and B causes C, and so B would be the cause.

Take the idea of white magic, or, what it really is, superstition. Some of us are afraid to sit down when there are thirteen at the table, for fear we might die during the year. Such a belief seems foolish. Is there any relationship between cause and effect in this case; and what is B? There is a certain inevitable mortality—does one of the individuals have a bad heart, or an advanced nephritis, or anything which would function as B. This idea, that, simply because in a given number of cases a certain phenomenon follows, the relationship is causal, is one of the greatest impediments to accurate thinking.

Experience is obtained through our senses, through observation, we might say. No two people see alike. Half a dozen people witness an accident. If you are an automobile driver, you will not envisage an automobile accident as someone else would. If you had been in an automobile accident, you would see it in quite another way altogether.

If you get an idea in your head that such and such things are in causal relationship—every time a certain thing happens, and it comes about as you expect it, you may emphasize that apparent confirmation of your theory, and ignore the negative results. I say to my medical students, when they are reading clinical literature, that the way to decide whether it is good or not is to see what results are reported. If they are all positive, and the author pays no attention to the negative ones, something may be wrong. Empiricists are interested in the things that fit their hypotheses, while the scientist is more interested in the negative cases, for they indicate unsuspected influences or realities.

I heard a physician say recently that he had saved many individuals—had kept them alive—by giving them whiskey. That is a topic which comes up often, especially since prohibition was decreed. It shows you how loose talk can be made to appear as a statement of fact. What I would ask is this: "Have you ever proved the fact that if you neglected the whiskey, the individual would have died?" That would be putting him in a difficult position, because no one would do such a thing, but nevertheless, to establish the truth of his statement, he would have to *prove* that failure to use whiskey would have caused death. Clinical experience is a variable thing, and is dependent upon so many different factors of thought, and observation, and control, that the clinician should be as generous with the scientist as I hope the scientist is with the clinician.

White magic is not worth very much. If I have succeeded in emphasizing this part of Dr. Todd's very enjoyable paper, I shall feel that I have been justified in taking your time for this purpose.

Harold D. Senior, M.D. (*New York City*): The hour is late, but I should like to say that I have enjoyed the entertaining paper we heard to-night. This paper, of course, deals very largely with the history of medicine and dentistry, and with things by which our sciences have been kept back. As Dr. Todd's paper promised to deal with historical matters, I did my best to wriggle out of discussing it, for I know nothing about the history of dentistry. I have come in contact with the history of medicine, and I find it so difficult to discover the truth, that I would not think of discussing the history of dentistry without a more adequate knowledge of the subject. We do not know much about the past, but we hope for the future, and we should be interested in that.

We have heard a great deal this evening about rigorous thinking, which is a pretty difficult thing—I have tried it myself once or twice. I do not know whether anatomy can be called a science. It is very difficult to discover with any degree of success how nature does things. Occasionally, one gets a "hunch" and has to dig in to see whether that "hunch" is right or not. Even when one does succeed in eliciting a new fact, it takes a long time to find out where that fact fits and to trace out all its implications. It is seldom that one comes across anything that seems really to be new with regard to the structure of the human body, and it takes a long time to find the essential meaning of what has been discovered.

It is to be hoped that all the laboratories in our schools will be engaged in research. Those of us who have come into the dental school from the study of general anatomy have a lot to learn about the teeth. We have not been particularly interested in them, nor, perhaps, in bones. I, myself, have been particularly interested in the arteries, mostly in those below the belt; but an elevation also of one's sphere of thought to the head would yield a great deal that might be of interest.

For instance I want to know why the internal maxillary artery should be on the outer surface of the external pterygoid muscle in about half the cases one investigates, and on the inner surface in the remainder. I think the proportion is about 48–52. That problem is one that has interested me, because there are very few arteries that are quite so inconstant in position. This internal maxillary artery itself is a very curious vessel. In early development it is connected with the internal carotid and goes through the tympanum, in which it pierces the stapes, then passes into the cranial cavity, and finally gets into the orbit. It gives off the infraorbital artery and the inferior alveolar by means of a common stem, which then goes through a little hole in the base of the skull and becomes the middle meningeal. This primitive internal maxillary (or the stapedial artery) occurs in

all human embryos, but at a certain time the external carotid gives off a branch which unites with the infraorbital and inferior alveolar, and becomes the stem of the permanent internal maxillary. The development of the stapedial artery was worked out by Tandler, of Vienna. The internal maxillary artery is interesting to dentists because it supplies all the teeth.

We, of the medical school, are a little overpowered just now by coming into contact with so many new things. One cannot help being struck by the immense amount of work that is being done in practical dentistry. We hear much about the good work that is being done with the x-ray and in other directions, and we should be able to get some of the younger men to take time in the earlier stages of their careers to interest themselves in such work. We have lots of good material to draw from.

I hope the time is not far distant when anatomy will have become a sufficiently exact science to permit the employment of rigorous thinking.

SOME OF THE FINDINGS AND CONCLUSIONS OF THE CARNEGIE FOUNDATION'S STUDY OF DENTAL EDUCATION[1]

The Two-Three-Graduate Plan

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I. Introduction

When this address was delivered, bound copies of printer's proofs of the writer's report to the Carnegie Foundation for the Advancement of Teaching, and of President Pritchett's preface, were about to be presented to representatives of all of the dental schools in North America and to additional advisers.[2] The report was recently issued as the Carnegie Foundation's Bulletin Number Nineteen,[3] where all of the findings and conclusions are now available. In the desire to avoid repetition, this record will be restricted to a synopsis of the two-three-graduate plan, which was the main theme of the address.

[1] The subject of an address at a meeting of the New York Academy of Dentistry, Hotel Belmont, New York City, February 25, 1926.

[2] Bound copies of the proof (xxii + 599 pages without appendix and index) were widely circulated shortly afterward.

[3] Dental Education in the United States and Canada: Bulletin Number Nineteen, Carnegie Foundation for the Advancement of Teaching, 1926. By William J. Gies, with a Preface by Henry S. Pritchett, President of the Foundation. Pp. xxii + 692. Published by the Foundation (June 27, 1927). Copies may be obtained free of charge on application, by letter or in person, at the office of the Foundation, 522 Fifth Ave., New York City.

II. Synopsis of the Two-Three-Graduate Plan for the Improvement of Dental Education[4]

ANATOMY (I—A–C; II—D–F)

I. SKELETON (A, B, C)

(A) At least two years of approved work in an accredited academic college (to place dentistry on a broader basis of general education; also to test the student's aptitude for dental practice). *See II, D*

(B) At least three years of intensive and integrated professional training (for the safe initiation of dependable general practice only, and to assure for the practitioner both ability to teach himself, and capacity to grow in proficiency from self-instruction and experience). *See II, E*

(C) Optional, full-year, graduate curricula (for systematic training in all types of dental and oral specialization, including teaching and research). *See II, F*

II. BODY AS A WHOLE (D–F; 1–13)

(D) *At least two years of approved work in an accredited academic college (to place dentistry on a broader basis of general education; also to test the student's aptitude for dental practice—1–3). See I, A.* This work to include, among the various prescribed courses and electives (1, 2, 3)

(1) The conventional basic courses in academic sciences, which are not only "cultural," but also preparatory *in general* for the study of dentistry (similar to current pre-medical requirements)

(2) Extra pre-dental courses (a, b, c), which are not only "cultural," but also preparatory *in particular* for the study of dentistry (not included in current pre-medical requirements)

[4] The two-three-graduate plan was first presented publicly at a meeting of the American Association of Dental Schools, Congress Hotel, Chicago, March 6, 1924. This synopsis, prepared for the writer's use at the meeting of the New York Academy of Dentistry, February 25, 1926, was included also in a paper read at the First Pacific Coast Dental Conference, Municipal Auditorium, Portland, Oregon, June 23, 1926 (*Pacific Dental Gazette*, 1926, xxxiv, p. 702). The two-three-graduate plan receives detailed attention on pages 179–206 of the Carnegie Bulletin (footnote 3).

(a) Oral normality and dental health (oral hygiene, as a part of the general health work of the academic college). *See IV, I, J*

(b) The principles of mechanics (in extension of physics), with adapted shop practice the demonstration and laboratory phases. *See IV, I, K, L*

(c) The principles of esthetics, with fine art in drawing, painting, sculpture, modeling, carving, molding, metal working, etc.—some or all of them the demonstration and laboratory phases. *See IV, I, K, L*

(3) All (1 and 2) arranged in a program to afford, also, a sound and acceptable equivalent of the first and second years for an academic bachelor degree; and, wherever specially high scholastic attainments for the degree are demanded, to include extra summer courses in an accredited academic college

(E) *At least three years of intensive and integrated professional training (for the safe initiation of dependable general practice only, and to assure for the practitioner both ability to teach himself, and capacity to grow in proficiency from self-instruction and experience—4–9). See I, B*

(4) The professional work to be based directly (d, e)

(d) On the sciences and arts taught in the academic college (D, 1, 2, a–c)

(e) On the oral interest, digital facility, and artistic felicity cultivated initially by the academic courses in hygiene, mechanics, and esthetics, respectively (D, 2, a–c); to be further improved by training in the medical sciences and in dental technology (E, 5, f, g)

(5) The instruction to be imparted through a professional curriculum designed to teach what a general practitioner should understand, do, and be able to advise; and also to facilitate his future study and self-instruction. To include (f–j)

(f) Fundamentals of the related medical sciences, in courses similar in general scope and quality to those for students of medicine, but effectually adapted to the needs of the general practitioner of dentistry

(g) Applied mechanics and applied esthetics (dental technology)

(h) Clinical dentistry

(i) Correlations of the general aspects of clinical medicine and clinical dentistry—the elements of oral medicine—with directed experience in a dispensary, and coordinated observations in a hospital (externe service)

(j) All (f–i) carefully integrated to train systematically for general practice only

(6) The *extensions* of all dental and oral specialties, such as maxillo-facial surgery and orthodontia, to be postponed for systematic graduate study (F, 10–12); but the training of the general dental practitioner to include, of the specialties, the essentials of diagnosis, the recognition and treatment of abnormality or disease in its incipiency, and the development of proficiency in ways and means of meeting emergencies

(7) The first two professional years to be an equivalent of the third and fourth academic years for an academic bachelor degree; to be awarded only to students attaining scholarship above a specified high grade—and at the end of the second or third professional year, in accordance with local preference

(8) One, two, or all of the three professional years to be lengthened, if desirable, to the full clock-hour content of a maximum of four conventional years, by prefixing summer sessions ("quarters") or by other means, as local or special conditions may determine. (This feature of the two-three-graduate plan gives the three-year undergraduate professional phase the maximum degree of clock-hour elasticity)

(9) One of the degrees required for a dental license (D.D.S. or D.M.D. at present) to be awarded to successful candidates, and to *successful* candidates only, at the end of the third professional year

(F) *Optional, full-year, graduate curricula (for systematic training in all types of dental and oral specialization, including teaching and research—10–12). See I, C.* (Not to be confused with "advanced courses for practitioners," so-called "post-graduate" courses—III, G, 16)

(10) To be open to graduates of the three-year curriculum for general practitioners (II, E, 4–9), or the equivalent—also to physicians and to qualified graduate students generally—and to afford all desirable graduate opportunities, including adequate dispensary and hospital facilities (and interneships)

(11) The degree of Master of Science or Doctor of Dental Science to be awarded at the end of the first graduate year, on the basis of acceptable scholarship and proficiency

(12) The degree of Ph.D. to be awarded for graduate work of the highest quality, in accordance with university customs

(13) State boards (if they approve this plan) to license, as accredited specialists (*subsequent to a specified date in each state*), only those who pass special license examinations after the successful completion of full-year graduate curricula in acceptable schools

ATTENDANTS (III–G)

III. COLLATERAL CURRICULA (G; 14–17)

(G) In university schools that can adequately support extra curricula, not in schools that cannot (14–17)

(14) Combined dental and medical curricula, with or without graduate extensions, for dental and oral specializations on particularly broad medical foundations, especially for maxillo-facial surgeons,

oral surgeons, orthodontists, and physicians learned in the principles of stomatology—phases of practice that most intimately embrace the joint responsibilities of medical and dental service—all leading to appropriate degrees

(15) A curriculum for dental hygienists

(16) Advanced (short) courses for practitioners and for special students—so-called "post-graduate" courses. (To be distinguished from graduate courses—II, F)

(17) Extension courses for practitioners, and for technicians and assistants

PHYSIOLOGY (IV—H–Q)

IV. CHIEF FUNCTIONS (H–Q)

(H) To facilitate achievement of (18–20)

(18) A high though readily attainable plane of sincere general education in the academic college (II, D, 1–3)

(19) Close coordination of the cultural education with intensive and thoroughly integrated training for general practice only (II, E, 4–9)

(20) Systematic specialization, through the agency of optional, full-year, graduate curricula, in any direction and to any extent, after previous effectual training for general practice (II, F, 10–13)

(I) To discover, test, and stimulate, during the academic years, the student's aptitude for dentistry, or to reveal his ineptitude, without impairment of his cultural education. To be accomplished through the agency of extra courses in oral hygiene, mechanics, and esthetics (II, D, 2, a–c)—in academic colleges of universities having dental schools, with the aid of special representatives of the universities—the prospective dental students in an academic college, as a group, to be under the very general guidance of a wise, sympathetic, and inspiring member of the associated dental

faculty, who would occasionally meet them informally as counsellor and friend, if and so long as they cared to confer with him.[5]

(J) To emphasize in the academic college, and bring early to the attention of prospective dental students, the ideals of oral normality and also effectual means of maintaining personal oral hygiene, this instruction, under the direction of a representative of the dental faculty (IV, I), to be a part of the general health program, and to include optional visits to the dental school, and demonstrations there under his direction (II, D, 2, a)[5]

(K) To give the prospective dental student in the academic college early favorable opportunity to test for himself, especially through the work in mechanics and esthetics, his aptitude for the practice of dentistry; to provide scientific and manual foundations for the technical work in the dental school; and also to make it possible, without disregard for the maintenance of digital skill in practice, to shorten the period ordinarily devoted in the professional curriculum to over-training in dental mechanics (II, D, 2, b)[5]

(L) To exemplify in the academic college, in the cultural work in esthetics and fine art, the principles of the science of beauty; the instruction to be adapted—from conventional university fine-art courses in drawing, painting, sculpture, modeling, carving, molding, metal working, silver-smithing, etc.—to the needs of prospective dental students; thus also to stimulate ability for the practice of dentistry or to reveal ineptitude, and to augment, further, the saving of time in the professional curriculum in the teaching of dental technology (II, D, 2, c)[5]

[5] ***Note relating to items I, J, K, and L, above.*** Students at academic colleges where these combined cultural and vocational purposes could not be achieved, might be required, for admission to a given university dental school on this program, to take adequate summer courses at the academic college associated with that dental school, or at another accredited academic college similarly related to a dental school.

(M) To change the present concept of "general practitioner" to represent the ideal of *general* practitioner as distinct from *miscellaneous* practitioner, which would involve better professional education for the "average" dentist, and consequent greater ability to render all of the service of a general practice in modern oral health-service, without wasteful attention to specialization in the general training (II, E, 5, 6)

(N) To promote true graduate study and research, and to obtain the consequent improvement in methods of teaching and in means for prevention. The award of a bachelor degree at the end of the second or third professional year—at a high level of scholastic attainment (II, D, 3; E, 7) and after extra summer sessions, where preferred (II, E, 8)—would facilitate systematic graduate study for all types of dental and oral specialization, immediately after graduation from the three-year professional curriculum, or preferably after one or more years of general practice (II, F, 10), which, if made obligatory for specialists (II, F, 13), would end the present deplorable impositions on the public by specialization that often is such in name only. By this method teachers would be discovered, dental faculties greatly improved, and research markedly advanced (II, F, 10–13)

(O) To give dentistry greater mechanical facility and artistic distinction in oral restoration, in close conformity, however, with the paramount requirements of health service

(P) To imbue dentistry with a sense of its obligation in research, and of its outstanding duty to achieve effectual prevention of all types of oral deficiency

(Q) To make dentistry as a whole, in service for the patient, the full equivalent of an oral specialty of the practice of conventional medicine, without basing it on the current requirements for an M.D. degree (21–23)

(21) By putting dentistry on a plane of academic and

scientific equality with medicine, as measured in terms of understanding, ability, character, and success, not number of hours wasted or courses passed and forgotten in acquiring the practice degree, nor professional customs or privileges idolized, nor other misleading criteria

(22) By giving dentistry a mind and an aspiration of the highest medical quality in oral health-service

(23) By affording dentistry a practical mastery of the sciences and arts in the whole field of stomatology, where dentistry and medicine, meeting without exclusiveness, must cooperate with equal competency and in mutual respect *for the benefit of the patient*

PSYCHOLOGY (V—R–U)

V. MAIN ELEMENTS IN ITS PHILOSOPHY (R–U)

(R) Recognition of the fact that dentistry is a division of health service, and of the need, in the public interest, for the continued progressive development of dentistry as a separately organized profession

(S) Realization that such independence (R) requires the evolution of dentistry into the full health-service equivalence of a specialty of the practice of conventional medicine, and that this growth necessitates continual constructive change through study and experiment

(T) Acceptance by dentistry not only of enlarging professional responsibility in health service, in all aspects of its practice, but also of the condition that service equality with an oral specialty of medicine is attainable through equivalence in intrinsic educational and professional merit, not by aping identity

(U) Comprehension that the most important oral restorations have the opportunity and responsibility of fine art, and that such prosthesis must be not only remedial for physical disability and for mental distress, but also fully in accord with all of the biological requirements of oral physiology

GENERAL INFLUENCES (VI—V–Z)

VI. PROSPECTIVE ACHIEVEMENTS (V–Z)

(V) As a plan for complete and coordinated professional education of the highest quality, it will bring to dentistry a deeper sense of self-respect, and a broader public appreciation

(W) The provisions for effectual instruction in the present and future requirements of each main unit of dental education —preparatory, general, and graduate—and for the intimate coordination of all the units, give the plan a quality analogous to that of an adult person who is capable of further muscular and mental development *without increasing in height.* Its provisions hold out the prospect that dental education can be stabilized by timely readjustments on the "skeleton" (I, A–C), without impairment of any of dentistry's powers, and without retarding the evolution of dentistry's intellectual or professional capabilities

(X) The inherent cumulative educational force of the plan will (24–28)

(24) Help to maintain the dignified separate organization of dentistry

(25) Place dentistry, as an important division of health service, on a plane of intellectual, professional, and social equality with the accredited specialties of medical practice

(26) Promote accord and cooperation between the practitioners of dentistry and of medicine, and of all other divisions of health service

(27) Bring into much higher relief the esthetic responsibilities and also the artistic capabilities of the restorative aspects of dental practice against the background of routine mechanical repair

(28) Advance teaching and research, and strengthen the means for prevention

(Y) The intrinsic intellectual nature of the plan will encourage in dental students the qualities of humility and curiosity,

the attributes of open-mindedness and analysis, which are not only active influences in the best practice, but also primary factors in the broad advancement of research, on which depends the continual extension and refinement of oral health-service in prevention, cure, or relief

(Z) The idealism of the plan, which is based on realism, will achieve the supremacy of the higher values that afford for any profession and its devotees the fullest measures of public service and of abiding contentment

III. Addendum

At the "First Pacific Coast Dental Conference," in Portland, Oregon, in June, 1926, a paper[6] that embodied the views expressed in the address at the February meeting of the New York Academy of Dentistry, including a synopsis of the two-three-graduate plan, was discussed by Dean Guy S. Millberry,[7] who said (page 709) that "Dr. Gies . . . . believes that dentistry should be a *full* oral specialty of medicine," and then proceeded to indicate reasons why the "full educational requirement" cannot be "compressed" into "five years." But, instead, the writer suggested (as in the foregoing synopsis—IV, Q, 21–23) that, in service for the patient, dentistry should be made the *full equivalent* of an oral specialty of the practice of conventional medicine, which obviously is a different objective. Dr. Millberry evidently failed to note the import of the following statement in the paper he was discussing (p. 699):

"The desired development of dentistry, to the *quality* of an oral specialty of medicine, can be accomplished without requiring general practitioners to become doctors of medicine. Much of the medical curriculum is redundant at best, and for the practice of dentistry would be useless. Dentistry can

[6] Gies: *Pacific Dental Gazette*, 1926, xxxiv, pp. 698. The writer was unable to attend the Conference, but the paper was read in his absence. He did not receive a printer's proof of the paper, nor the manuscript nor a printer's proof of the discussion, and therefore was unable to correct typographical errors in the paper or to respond to Dean Millberry's comment. The italic in the quotations does not appear in the original.

[7] Millberry: *Ibid.*, pp. 709–716. The italic in the quotations does not appear in the original.

and should be made the full equivalent of an oral specialty of medicine, without any weakening of its mechanical facility or any impairment of its artistic felicity. To require the addition of a dental training to a [full] medical training for the practice of dentistry is impractical for all but a few. Dentistry rests upon medicine, mechanics, and esthetics. Each leg in the tripod should be kept as long as the others, but they need not be equal in width."

Dean Millberry, in the same discussion, irrelevantly expressing impatience about the delay in the publication of the writer's report on the Carnegie Foundation's study of dental education, said (p. 709) that "the survey was completed in 1922 [*sic*] and we have been waiting four years for the report. It is not yet off the press . . . ." But all of the deans of dental schools in North America knew that the "survey," including visits to dental schools, was in progress from 1921 to 1926, and that the delay in the publication of the report was due to the steady continuance of the study throughout that long period. In the preface of the Bulletin on Dental Education (written in January, 1926, six months before the Portland Conference), President Pritchett said on this subject (pp. xv–xvi):

"It has taken five years to complete the work. This has been due not only to the need to obtain exact facts, but also to the long and patient effort that Dr. Gies has made to understand the situation and to advise with the dental profession. No study of this character has ever been made in which there has been so complete coöperation on the part of the profession itself."

Dean Millberry asserted also (p. 710) that the writer, in the paper then before the house, "speaks in terms of general disparagement of the dental profession." But Dean Millberry plainly misinterpreted the writer's comment, especially the import of this statement (pp. 698–99):

"The long continued indifference of medicine to the abnormalities and diseases of the teeth and oral tissues suggests that, if dentistry were called stomatology and added to medicine, oral health-service would continue to be neglected by the medical profession. The success with which dentists have brought dentistry to its present state of usefulness and opportunity, in the face of social disparagement and professional belittlement, shows

very plainly that the leadership of the dental profession is alive to its responsibility and will develop dentistry to its full possibilities in health service."

Dean Millberry also said (p. 712) that, "according to Dr. Gies' report, the two-three plan [*sic*] is the *only plan* for dentistry." But the writer has never proposed a "two-three plan."[8] When this remark was made, Dean Millberry disregarded the following statement in the paper under discussion (pp. 700–702):

"The educational plan that seems to promise the widest usefulness in the United States is what we have conveniently called the 'two-three-graduate plan.' This plan is conservative in its demand for time; progressive in its elevation of spirit, purpose, and means, yet moderate in its economic exactions and in its deviation from prevailing views; and also *elastic in its relation to the preferences of individual schools*. . . . . Other plans, such as the 'nought-five,' the 'one-four,' or *the two-four form* of the two-three phase of our plan, *have much to commend them*. . . . . I venture to predict that as soon as the two-three-graduate plan is fully understood, especially the significance of its academic and *graduate* phases, and the fact that *three long professional years will be more useful than four short ones* where the latter are now preferred—then that plan will become the accepted *basis* for a stabilized procedure in dental education. The plan will grow in favor, after partisanships die out, because it carries the foundations for an enduring program in professional education in general."

Before the writer's position had been thus stated at the Pacific Conference, Dean Millberry had an opportunity, also, with many others, to note the following comment regarding the two-three-graduate plan, as published later in the Bulletin on Dental Education (pp. 204–205):

"The plan, a tripartite program of essentials, is like a skeleton rather than a fully organized body, and therefore, in its use, is *susceptible of wide variation and of free expression of preferences*. Its primary phases can be adopted separately, experimentally, and gradually, without impairment of

[8] The frequency with which Dean Millberry, in his discussion, ignored the graduate phase of the two-three-graduate plan suggests that the integral relation of graduate work to the whole plan was not appreciated by him. The two-three-graduate plan could not accomplish the suggested improvement of dental education, if it were operated as a "two-three" plan without a graduate phase. The same is true of the two-four plan.

the system into which they may be fitted. *It would impart both elasticity and diversity to dental education, for it is neither a mould nor a straitjacket.* It suggests conditions that are suitable for general adoption as *minima.* By lengthening the professional years so that three would have the content of four, schools that now prefer a conventional two-four plan without reference to graduate work could save a year of the practitioner's time for professional service. Tuition fees, teaching salaries, etc., would presumably be readjusted accordingly. The optional graduate phase *provides in effect, by addition, two-four, two-five, and two-six plans* culminating in all aspects of oral specialization and research. The plan presents a basis for close cooperation between medical and dental schools, and favors an evolution in the relationship between medicine and dentistry that would be entirely natural and in full accord with the future responsibilities of each."

Unwarranted remarks by Dean Millberry, like those quoted above, abound in the published account of his comment on the writer's paper, but it has been sufficient historically to quote only a few of them, and to facilitate reference to the original paper and to the discussion.

To help future students of the two-three-graduate plan to understand some of the emotional difficulties attending its consideration, the following comment by Dean Millberry is given wider circulation (page 716):

"I believe that the two-three plan[9] in dental education is the figmentation [*sic*][10] of an impractical mind, or group of minds,[11] and that it will soon be discontinued or modified."

Other views may be cited in amelioration of the severity of this opinion. Six months earlier (January 13, 1926), President Pritchett, in his preface in the Bulletin on Dental Education, alluded to this plan as follows (pp. xvii–xviii):

"It should be clearly understood that . . . . [the two-three-graduate plan] is an honest and sincere effort, first to secure educated men for the

[9] See footnote 8.

[10] "Figmentation" does not seem to be a misprint for pigmentation. Probably Dean Millberry said or intended to say "figment."

[11] The writer confesses that he alone must bear the full responsibility.

profession and secondly to integrate the professional course for general dentistry into a feasible and effective process of professional training. Under this arrangement a better educated man will devote more hours in three years to direct preparation for his profession than are now given in four years by men generally less highly educated. The plan seeks to integrate the scientific and technical studies of the dental school. It proposes, in addition, to offer the dental specialties in one or more graduate years. . . . . [It] ought to be of the greatest possible interest [also] to members of the medical profession and teachers in medical schools. . . . . The [proposed] process of integration of the dental curriculum must obviously be one of experimentation. . . . . "

The Dental Educational Council, which seems to be a very practical organization, regards the two-three-graduate plan as an acceptable basis for its class-A rating. The Council, which is an official representative of the organized dental profession in the United States, voted, in December 1926, that the undergraduate curriculum need not prescribe more than a total of about 3700 clock hours—700 less than the previous minimum total requirement—for the Council's Class A or Class B rating. Already four class-A dental schools (Marquette, Michigan, Minnesota, Pittsburgh) are conducting their instruction on the two-three-graduate plan.

The Department of Education of the State of New York has recently published the following memorandum relating to the undergraduate dental curriculum:

"Approved Course of Study for Dental Schools"

"The following shall be the minimum course of study for *all schools seeking to be registered or to be accredited by the Regents*. The course may be completed in four years of two semesters each, or *in three years of four quarters each*;[12] that is, the course may be completed in 8 semesters of 16 weeks each, or in 12 quarters of 11 weeks each, allowing one week in each semester or quarter for examination [italic not in the original]:

[12] See item II, E, 8, in the synopsis of the two-three-graduate plan on page 444; also the quotation, on page 453, from the Carnegie Bulletin on Dental Education.

Subjects		*Semester credits*	*Clock hours*
Anatomy:			
Gross anatomy	8		
Histology and embryology	6		
Dental anatomy	3	17	400 to 500
Bacteriology and immunology		5	150 to 200
Biochemistry		4	100 to 150
Electives (clinical medicine, 4 hrs.)		9	100 to 150
Hygiene and sanitation: general and oral		5	75 to 150
Medicine, and externe hospital service		12	300 to 400
Metallurgy		3	50 to 75
Operative dentistry		18	800 800
Orthodontia		2	64 64
Pathology: general and oral		7	150 to 200
Pharmacology		3	50 to 100
Physiology		8	150 to 200
Prosthesis (including crown and bridge-work)		24	1000 1000
Seminar and conference courses in economics, ethics, history and literature of dentistry, jurisprudence		2	32 to 48
Surgery—general and oral: anesthesia, principles of surgery, surgical technique		7	150 to 200
Therapeutics		2	32 to 48
Total		128	3603 to 4285

"The minimum course of study may not be less than 128 semester credits nor less than 3600 clock hours; the maximum number of clock hours may not exceed 4400.

"The difference between these aggregates may be utilized as institutions may deem desirable.

"No student shall accumulate more than 48 credit hours in any one calendar year, and no student shall carry more than 17 semester hours at any one time."

This memorandum, on the new minimum curricular requirements for dental schools registered in New York, records the fact that the two-four plan and the two-three phase of the two-three-graduate plan may be made fully equivalent, mathematically and educationally.

437 West 59th Street

MEDICO-DENTAL CASE RECORDS: FOURTH REPORT[1]

A Clinico-pathological Study

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I. Case GI-1 (1)[2]: Pyloric Ulcer (2)

INTRODUCTION: CHIEF COMPLAINT

The patient had been admitted to the hospital[3] for observation and treatment three times within a year (July 1924 to July 1925). The first admission was on July 7, 1924, when the chief complaint (3) was abdominal pain complicated by gastric distress. The patient was admitted to the hospital for the second time, on December 6, 1924, for observation and diagnosis of an abdominal condition, the symptoms

[1] The preceding reports were published in the *Journal of Dental Research:* (1) 1926, vi, p. 283; (2) 1927, vii, p. 115; (3) *Ibid.*, p. 275.

[2] The numerals in parenthesis refer to the numbered items in "Notes and comment," on page 468.

[3] The Fifth Avenue Hospital, New York City.

of which were similar in character to those present at the time of the previous admission. The third admission, on July 7, 1925, was for the treatment of a sprained ankle and other injuries which had been sustained in an automobile accident. At the time of the third entry to the hospital, the patient again complained of the return of the abdominal symptoms, which had been the chief complaint at each of the earlier admissions.

FIRST AND SECOND ADMISSIONS

General history and physical examination

The patient, thirty-three years old, was an officer in the motorcycle squad of the Police Department of the City of New York (4). There was no family history (5) of tuberculosis or cancer. His mother died of diabetes at the age of 53; his father and four sisters were living and well. The patient gave no past history (6) of any serious acute infectious disease, rheumatic fever, chorea, tuberculosis or venereal disease. Sixteen years ago he had pneumonia, but since has been well and strong. The patient's habits (7) were good; he smoked cigarettes moderately and consumed little alcohol since the advent of prohibition. His appetite had always been good, and he always ate rapidly. In June, 1924, he began to have attacks of aching pain in the epigastrium (8). The pain occurred several times a day, at irregular intervals, and apparently was not related to food consumption. The attacks lasted from several minutes to an hour, and were relieved by sodium bicarbonate. In the latter part of June the pain became more severe and localized in the right lower quadrant (9), at which time a provisional diagnosis of subacute appendicitis was made, and the patient was admitted to the hospital for operation (first admission). On July 7, appendectomy was performed and the pathological findings at the time of operation confirmed the provisional diagnosis. The patient had an uneventful recovery, and was able to leave the hospital on July 12, 1924. His condition at the time of discharge was "cured."

The severe pain in the right lower quadrant had been completely relieved by the appendectomy and there had been no return of that symptom since the patient's discharge from the hospital in July. The dull epigastric pain, however, had returned, had increased in severity

during the fall months, and the patient lost weight. It was, therefore, deemed advisable to readmit the patient to the hospital for observation, and accordingly he made his second entry on December 6, 1924.

Physical examination at the time of the second admission showed a well-developed but not particularly well-nourished man. The patient did not appear to be acutely ill or suffering from acute pain. He was mentally depressed and most reluctant to coöperate in any manner. He was exceedingly irritable, and several times refused medication and treatment. He apparently had little interest in his own welfare. His face and neck were scarred from acne (10), and there were papular lesions (11) upon the back and the back of the neck. The pupils were round and equal, and reacted promptly to light and accommodation (12). The hearing was good. The tonsils were small and cryptic but there was no evidence of pus. There was no enlargement of the thyroid or lymph-nodes. The chest was normal in shape; the supraclavicular fossae were deep. The lungs expanded equally and well, and no râles (13) were elicited. The heart sounds were normal and regular in rate, rhythm, and force. The heart was not enlarged to percussion. The abdomen showed a slight gaseous distention; there was no tenderness—no masses or herniae. The liver and spleen were not palpable. The extremities were normal; knee-jerks (14) were equal and active—no varicose veins, and no edema.

Report of the dental consultant

Clinical examination. "Examination of the mouth shows advanced chronic suppurative pericementitis (15), particularly in the region of the lower anterior teeth, and severe gingivitis of the tissues beneath and adjacent to the extension bridge supported by the right superior second bicuspid. There is a heavy deposition of salivary calculus, and pus may be found along the gingival margins at many locations. There is moderate dental caries. There is much reparative and reconstructive work, which has been poorly executed. The extension bridge has been the direct cause of severe and extensive tissue destruction, and the poorly-conformed shell crowns and overhanging metal fillings have been sources of gingival irritation. The left superior first bicuspid and right inferior first bicuspid are pulpless teeth which fail to respond to tests for vitality. Oral hygiene has obviously been neglected."

Roentgenographic examination. "Study of the roentgenograms reveals

the presence of pathological conditions of the periodontal (16) and periapical (17) tissues. Generalized alveolar absorption, resulting from chronic suppurative pericementitis, is apparent. There is a necrotic area posterior to the right inferior first bicuspid, and there is chronic rarefying osteitis (18) of the periapical tissues of the left superior first bicuspid."

Comment. "The extensive oral sepsis is probably an aggravating factor in this patient's general condition, and may possibly be the etiological factor."

Recommendations. "Advise, (a) the immediate removal of the extension bridge and (b) thorough oral prophylaxis with routine follow-up treatment of the gingival tissues; (c) removal of the infected pulpless teeth with special attention being directed at the areas of periapical infection of these teeth; and, (d) general repair or replacement of fillings that are deficient or poorly adapted, and (f) construction of dentures so as the masticating efficiency may be increased to a maximum."

Laboratory and miscellaneous data

The temperature, pulse and respiration were recorded within the limits of normal variation.

Blood pressure (19). Systolic, 100 mm.; diastolic, 70 mm.

Urinalysis (20). Amount, normal; specific gravity, 1.028; reaction, acid; albumin, sugar, and casts, absent. *Microscopic examination:* few white blood cells and occasional epithelial cells.

Blood examination (21). Hemoglobin, 78 per cent; red blood cells, 4,660,000 per cmm.; white blood cells, 9,000 per cmm.; polymorphonuclear leukocytes, 62 per cent; lymphocytes, 32 per cent; transitional leukocytes, 1 per cent; eosinophilic leukocytes, 4 per cent; basophilic leukocytes, 1 per cent.

Blood chemistry (22)—mg. per 100 cc. Urea, 17.9; uric acid, 4.5; creatinin, 0.8. CO_2, 67 per cent; sugar, 91 per cent. Blood complement fixation test, negative.

Roentgenographic examination of gastro-intestinal series. "Films made of the stomach immediately, and also six hours after the barium meal, show the following: Stomach—orthotonic type (23). Peristalsis (24)—three cycle; equal on the greater and lesser curvatures; obstructed in the extreme pyloric end (25); systole and diastole not characteristic. Parapylorics—the extreme pyloric end fails to expand or contract in a normal manner, and there is an induration involving the extreme pyloric end and pyloric sphinc-

ter (26); there is evidence of a crater of a rather large ulcer located approximately in the sphincter and just distal to the sphincter; the crater of the

FIG. 1. ROENTGENOGRAM TAKEN IN THE OBLIQUE POSITION SHOWING THE LOCATION OF THE PYLORIC ULCER AND THE RELATION OF THE ADJACENT ANATOMICAL STRUCTURES, DECEMBER 1924.

A.—Ulcer situated in the pyloric sphincter. *B*.—The pyloric end of the stomach. *C*.—The cap of the duodenum. *D*.—Contraction due to peristaltic wave.

ulcer is at least one-quarter of an inch in depth, the induration extending to the end of the pyloric end of the sphincter and into the cap (27); the cap

is destroyed. Duodenum (28), jejunum (29), and ileum (30) are normal. At six hours the stomach is completely empty, and the head of the column is in the transverse colon and the tail is in the ileum." (*Fig. 1.*)

Diagnosis. "From a study of these films one is justified in making a negative diagnosis of cancer of the stomach, and a positive diagnosis of ulcer involving the pyloric sphincter and adjacent portions of the cap and pyloric end of the stomach. There is a definite crater present as described in the findings. There is no pyloric obstruction as yet, for the stomach empties itself in six hours. The peristalsis was active."

Medical treatment

Complete rest in bed, institution of the Sippy diet (31), and elimination of oral sepsis, were the treatments prescribed. The elimination of oral sepsis was considered to be a particularly important phase of the general treatment, the attending physician having stated the belief that "oral sepsis is the probable etiological factor" in the patient's general condition.

Comment. It was impossible to complete the schedule of treatment because of the mental attitude of the patient, as mentioned in the general history. He was particularly adverse to the removal of the infected teeth and would not consent to having the routine oral hygiene treatments, which had been definitely outlined as an adjunct to the general treatment. The Sippy diet, however, was continued for twelve days and he apparently gained slightly by the treatment, as indicated by the roentogenological report of an examination made on December 17, which states: "The lesion involving the cap and sphincter has improved somewhat since the former examination; the crater of the ulcer is slightly smaller, which may indicate the beginning of a healing process. There is no stenosis, as the stomach empties in six hours."

The patient was discharged from the hospital on December 18. His condition was designated as "improved." There had been no treatment of oral sepsis during this admission.

THIRD ADMISSION

Interval history and physical examination

The patient reëntered the hospital on July 7, 1925, for the treatment of a sprain of the right ankle. Following his last previous

discharge from the hospital there had been some improvement in his general condition, with an abatement of the symptoms of epigastric discomfort. The apparent improvement, however, was not sustained and at the time of his third admission, the old symptoms were manifesting, there had been some loss of weight, and there had developed a general feeling of lassitude, malaise, and indisposition to work.

The physical examination was principally as noted on the occasion of the second admission (December, 1924), with the exception of the injury to the right ankle. The return of the symptoms indicated that the ulcer had not healed, and admission to the hospital for treatment of the injury to the ankle afforded an opportunity for further observation and treatment of the general condition.

Laboratory and miscellaneous data

The temperature, pulse and respiration were recorded within the normal range of variation.

Urinalysis. Normal.

Blood examination (21). White blood cells, 8,000 per cmm.; polymorphonuclear leukocytes, 64 per cent; lymphocytes, 32 per cent; transitional leukocytes, 2 per cent; eosinophilic leukocytes, 1 per cent; basophilic leukocytes, 1 per cent.

Roentgenographic examination (July 14, 1925). "Films were made of the stomach immediately, two and six hours after the ingestion of a barium meal. There was apparently more spasm of the pyloris at the present time than at the former examination. In the lateral direction the crater of the ulcer is seen. *There has been no apparent improvement*[4] in the condition of the ulcer. There was no gastric retention, as the stomach empties itself within the six hour period."

Treatment and operations

Medical treatment. (a) Local treatment for sprain of the right ankle, and (b) bland diet (32) for the pyloric ulcer; five feedings in twenty-four hours with plenty of milk and eggs.

Dental treatment. The extension bridge supported by the right superior second bicuspid was removed. There was a marked septic

[4] Italics not in the original.

condition of the tissues beneath the bridge, with free pus in evidence. Routine oral hygiene treatments were instituted to restore the gingival tissue to a healthy condition, and procedures of general operative dentistry were started.

Oral surgical procedure. The left superior first bicuspid and right inferior first bicuspid were removed under local anesthesia. Six cc. of 2 per cent procain-suprarenin were employed. There was chronic rarefying osteitis with granuloma formation of the left superior first bicuspid, and advanced periodontal disease. The right inferior first bicuspid had been affected by an advanced periodontal infection, and there was also a pathological condition at the apex (chronic rarefying osteitis with a granuloma). The periodontal infection distal to the inferior bicuspid had produced an area of necrosis posteriorly to the region of the first molar. The areas of infection were lightly curetted and given the usual post-operative treatments. No exacerbation (33) was manifested.

Bacteriological report. Cultures from the apices of the infected teeth showed streptococcus hemolyticus and staphylococci, with streptococcus viridans predominating.

During the period of his third admission to the hospital, the patient was more willing to coöperate, and remained on a special diet and for rest until August 8. The roentgenological report of an examination made on July 31 (before the removal of the teeth) indicated that "peristalsis is more active, and the spasm of the pyloric end more evident. The deformity involving the cap and the sphincter is practically the same as at other examinations. The crater of the ulcer is not seen as distinctly as at the original examination, as there is much deformity in this region from cicatricial contraction."

The condition of the patient was designated as "improved" when he was discharged from the hospital.

FOLLOW-UP EXAMINATION

Follow-up examination was made on February 15, 1927, when the patient returned to the hospital for roentgenographic examination. This examination was made one year and six months after the removal of the infected teeth. Gastro-intestinal series were made of the stomach in the erect, prone, and oblique positions. The films showed that

there was slight spasm of the pyloric end of the stomach and some deformity of the cap (due to the formation of cicatricial tissue). The

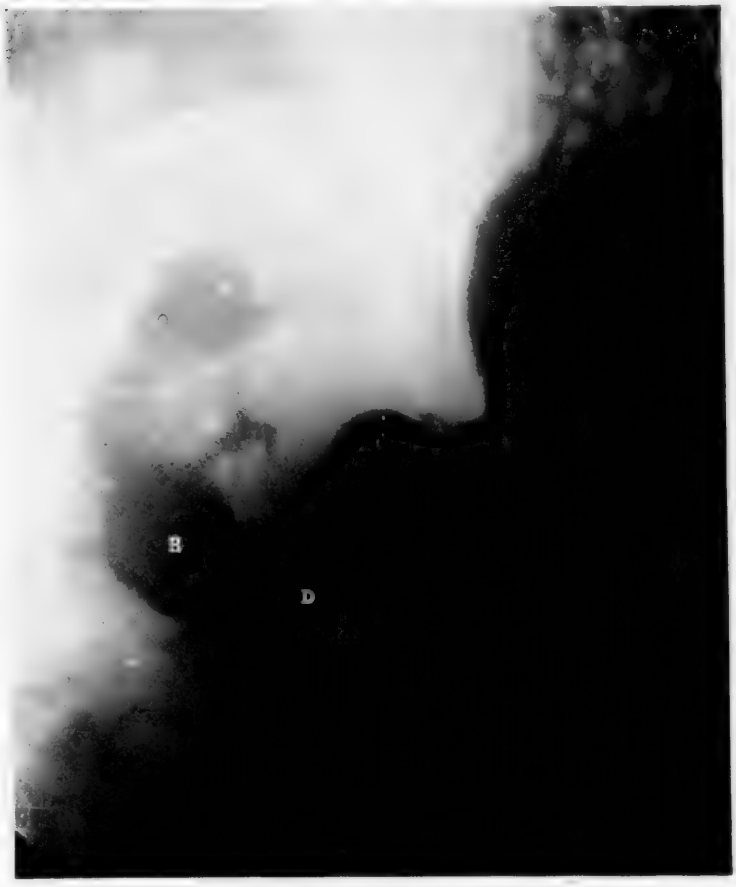

FIG. 2. ROENTGENOGRAM TAKEN IN THE OBLIQUE POSITION, FEBRUARY 1927.

A.—The site of the ulcer in December 1924, now not in evidence and apparently healed. *B*.—The pyloric end of the stomach. *C*.—The cap of the duodenum. *D*.—Contraction due to peristaltic wave.

cap showed less involvement than at the previous examination and the general appearance seemed to be improved. (*Fig. 2.*)

The patient had felt considerably better, there had been an increase in weight, and almost entire relief from the epigastric distress.

Comment. It was the opinion of the attending physician that the patient's condition had definitely improved, as evidenced by the roentgenographic examination and the patient's subjective feelings. The improvement was attributed to both medical treatment and the elimination of the oral foci of infection, and it seemed doubtful whether this improvement could have been effected without the removal of the dental infection.

II. General Summary

The patient was admitted to the hospital in December, 1924, suffering from epigastric distress. During this admission, the condition was diagnosed as pyloric ulcer. A course of treatment for the condition was outlined, which consisted of the routine medical treatment with special diet and medication, plus the elimination of the oral foci of infection. The patient would not consent to the removal of infected teeth or other necessary treatment to eliminate oral sepsis. He remained in the hospital about two weeks, and showed only slight improvement of the subjective symptoms at the end of this time. By July, 1925, the time of the patient's third admission to the hospital, the epigastric pain and general symptoms had returned and roentgenographic examination at this time showed "no apparent improvement." The patient was again given a special diet and a course of medication, and advised to submit to the treatment of dental infection. The patient this time consented to have the infected teeth removed and other necessary treatment instituted, all of which was accomplished before he left the hospital in August. Follow-up examination in February, 1927, one year and six months after his discharge from the hospital and after the elimination of dental infection, showed general improvement, both in the roentgenographic examination and in the patient's subjective symptoms. The condition at the time of the follow-up examination indicated that there had been no advance in the pathological process and that healing was evidently taking place. These data seem to justify the opinion that, in the absence of any other known foci of infection, failure to show a permanent improvement following the first course of treatment was probably due to the

existence of the dental foci of infection. This view is substantiated by the fact that after a similar course of treatment, in addition to which the dental foci were eliminated, the patient showed very definite improvement.

III. Conclusions

Anderson,[5] Haden,[6] Hufford,[7] Rosenow,[8] and Satterlee,[9] have emphasized the causal relation of focal infections to gastro-intestinal disturbances. Review of medical literature and analysis of this case-report justify the following general conclusions:

1. Infection from a primary focus may be an aggravating or an etiological factor in gastro-intestinal infections and lesions.

2. Oral focal infection may contribute directly to the etiology of ulcer of the stomach, or may be a constantly irritating factor. Periodontal and periapical infection may both be active agencies: periodontal infection may be an aggravating or etiological factor, because of the constant passage of pus from the mouth into the stomach; periapical infection, because of metastatic extension.

3. The effectiveness of medical treatment of ulcer of the stomach may be deterred by the presence of focal infections, and thus permanent improvement or cure may be unsuccessful.

4. The elimination of known primary foci of infection should be an early consideration in the routine medical treatment of gastro-intestinal lesions of infective origin.

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[5] Anderson, A. F. R.: Focal infections in chronic gastro-intestinal infection, *Annals of Clinical Medicine*, 1924, iii, p. 136.

[6] Hayden, R. L.: Elective localization of bacteria in peptic ulcer, *Archives of Internal Medicine*, 1925, xxxv, p. 457; also, Hayden, R. L., and Bonan, P. T.: Focal infection in peptic ulcer, *Journal of the American Medical Association*, 1925, lxxxiv, p. 409.

[7] Hufford, A. R.: Elective localization of streptococci from peptic ulcer in man, *Proceedings of Staff Meetings, Mayo Clinic*, 1927, ii, p. 54.

[8] Rosenow, E. C.: Focal infections and elective localization of bacteria in appendicitis, ulcer of the stomach, cholecystitis, and pancreatitis, *Surgery, Gynecology, and Obstetrics*, 1921, xxxiii, p. 19.

[9] Satterlee, G. R.: Effect of removal of dental infection on chronic gastro-intestinal disorders, *Medical Journal and Record*, 1924, cxix, p. 481; also, infection of the gastro-intestinal tract in systemic disorders, *American Journal of Medical Sciences*, 1922, clxiv, p. 313.

IV. Notes and Comment

EXPLANATORY AND SUPPLEMENTARY

It is believed that the medical notes in this section may be of value to some of the dental profession, while the dental notes may be of interest to members of the medical profession.

(1) Case GI-1. The cases reported in the present series are classified according to the diseases of the various organs and systems. Thus, the symbol GI, represents the diseases of the gastro-intestinal system.

(2) Pyloric ulcer. A gastric ulcer situated where the stomach joins the duodenum (the pyloris). The ulcer is a circumscribed loss of tissue, usually involving both the mucous membrane and deeper structures, and is characterized clinically by pain and local tenderness. Ulcer of the stomach may result from trauma or extensive superficial burns. It is frequently associated with diseases that impair the general health; anemia predisposes to gastric ulcer and it has been found in connection with cardio-vascular disease, tuberculosis, and syphilis. Infection is a most important factor. Osler[10] states that "any focal infection may be responsible, especially in the teeth or tonsils."

The symptoms of gastric or duodenal ulcer are epigastric tenderness, gnawing pain particularly when the stomach is empty, digestive disturbances, and loss of weight. Nausea and vomiting may occur, especially when the ulcer is near the pyloris. Sudden death may result from profuse hemorrhage following erosion of a large blood vessel, or from perforation through the stomach wall with the resultant peritonitis. The prognosis is favorable, if the condition is recognized early in its development. Acute ulcers yield best to medical treatment, whereas surgical treatment (gastro-enterostomy) is usually indicated for the chronic ulcer.

(3) Chief complaint. The chief complaint is the expression by the patient of the symptoms that cause greatest distress and which, drawing direct attention to the site of disease, indicate the line of investigation to be followed.

(4) Occupation. Enquiry as to the occupation of the patient is a routine consideration of history-taking, because certain occupational conditions or environments predispose to disease.

(5) Family history. Enquiry into the family history may reveal certain hereditary tendencies.

[10] Osler, William: The principles and practice of medicine, 10th ed.; revised by Thomas McCrey. D. Appleton and Co., New York and London, 1925.

(6) Past history. Enquiry into the past medical history is made for the purpose of ascertaining the previous diseases of the patient that may have a bearing upon the present illness.

(7) Habits. The patient's habits and personal hygiene may be predisposing factors to disease.

(8) Epigastrium. The upper central region of the abdomen (the epigastric region) which overlies the stomach, duodenum, liver, gall bladder, pancreas, and portions of the two kidneys.

(9) Right lower quadrant. This region of the abdomen overlies the cecum with the vermiform appendix, the ascending colon, the inferior half of the right kidney, the right fallopian tube and ovary, together with portions of the bladder and the uterus.

(10) Acne. A papular eruption due to inflammation, with accumulation of secretion, of the sebaceous glands.

(11) Papular. Relating to papules; small circumscribed elevations on the skin, containing no fluid (pimple).

(12) Pupillary reactions. (a) Reaction to light: the normal pupil, when exposed suddenly to light stimuli, responds by a reflex contraction of the iris. A sluggish reaction to light, or total abolition of the light reflex, signifies optic atrophy, partial or complete paralysis of the third cranial nerve, or degenerative changes in the ciliary ganglion. (b) Reaction to accommodation: when the range of vision is suddenly transferred from a distant objective point to an object near at hand, the pupils contract and the eyes converge. This is the reaction to accommodation. Abolition of this reflex is due to paralysis of the third cranial nerve.

(13) Râles. This term is applied to adventitious sounds which are generated in the pulmonary tract. These sounds are caused by the pressure of serum, mucous, pus, or blood in the air passages, interfering with the free movement of air.

(14) Knee-jerk reflex. Obtained by striking the patellar tendon with a percussion hammer while the leg is flexed upon the thigh at a right angle. Exaggeration of the reflex is noted in spastic spinal paraplegia and cerebral hemorrhage. Abolition of the reflex is noted during the progress of tabes dorsalis, anterior poliomyelitis, peripheral neuritis, and trauma to the spinal cord at the level of the reflex arc (second, third, and fourth lumbar segments).

(15) Chronic suppurative pericementites (periodontoclasia). A disease process in which there is a destruction of both the soft and hard tissues that support the teeth.

(16) Periodontal. Relating to the supporting (investment) tissues surrounding the teeth.

(17) Periapical. Relating to the region of the bony tissue adjacent to the apices of the teeth.

(18) Chronic rarefying osteitis. This is the condition resulting from the thickening of the peridental membrane that takes place at the expense of the bone of the alveolar process. As proliferation of the round cells occurs, the bone becomes rarefied and finally destroyed, leaving the space filled with chronic inflammatory tissue, the granuloma (Blair and Ivy[11]).

(19) Blood-pressure. The force exerted by the blood upon the vessel walls. The pressure is measured in millimeters of mercury. Systolic pressure is the pressure of the blood during ventricular contraction (systole); diastolic pressure is the pressure of the blood during ventricular relaxation (diastole). In the normal adult, systolic blood pressure is broadly determined by adding 100 to the patient's age and expressing it in millimeters. The blood pressure here recorded is low for this individual.

(20) Urinalysis. This is practically a normal specimen. The specific gravity is slightly elevated.

(21) Blood examination. Blood normally contains the following cellular elements: Red blood cells, 5,000,000 per cmm.; white cells, 7,500 per cmm. The white blood cells may be differentiated mainly into the following types: (a) polymorphonuclear leukocytes, 60–70 per cent; (b) lymphocytes, 25–33 per cent. Transitional leukocytes, eosinophilic leukocytes, and basophilic leukocytes may be found in small numbers in normal blood. The normal hemoglobin is expressed in terms of percentage: 95–100 per cent is considered normal. The blood examination of this patient indicates a mild secondary anemia.

(22) Blood chemistry. Blood normally contains certain substances of diagnostic importance in problems of metabolism and excretion. The waste products, urea, uric acid, and creatinin, are of chief importance from the clinical point of view. The amounts present in the blood in health, per 100 cc., are as follows: Total non-protein nitrogen, 25–30 mg.; urea nitrogen, 12–15 mg.; uric acid, 2–3 mg.; creatinin, 1–2 mg. Higher figures are usually referable to accumulation of the respective substances in the blood because of defective elimination. In health each 100 cc. of blood contains about 100 mg. of sugar (glucose). One of the most reliable means of detecting acidosis and measuring its degree is to determine the capacity of the blood plasma to combine with carbon dioxide. This test is, therefore, included as a routine determination in the chemic examination of the blood.

[11] Blair, V. P., and Ivy, R. H.: Essentials of oral surgery. C. V. Mosby Co., St. Louis, 1923.

The normal range is 53 to 75 cc. of CO_2 per 100 cc. of blood. Figures below 50 per cent in adults indicate acidosis; below 30 per cent, severe acidosis.

(23) Orthotonic type. The normal type. Abnormal types are referred to as hypertonic or hypotonic.

(24) Peristalsis. The vermiform movement of the intestine; a wave of alternate circular contraction and relaxation, by which the contents are propelled onward.

(25) Pyloric end. The lower end of the stomach, which joins with the duodenum.

(26) Pyloric sphincter. A circular thickening of the muscular wall of the stomach surrounding the pyloric orifice, the aperture between the stomach and small intestine (duodenum).

(27) Cap. The first portion of the duodenum at the junction with the pyloric end of the stomach.

(28) Duodenum. The first division of the small intestine, about 11 inches in length, extending from the pyloris to the junction with the jejunum at the level of the first or second lumbar vertebra on the left side.

(29) Jejunum. The second division of the small intestine, about 8 feet in length, situated between the duodenum and the ileum.

(30) Ileum. The third portion of the small intestine, about 12 feet in length, extending from the junction with the jejunum to the ileocecal valve.

(31) Sippy diet. A special diet, which aims to reduce gastric acidity by appropriate food and alkali medication every hour during the greater part of the day. For the first few days the diet is restricted to three ounces of milk and cream every hour. After three or four days soft-boiled eggs and cereal may be added, and later in the treatment, cream soups and other soft food may also be included. The medication consists of alkaline powders, chiefly in the form of magnesia, with sodium bicarbonate, alternated with bismuth subcarbonate and sodium bicarbonate.

(32) Bland diet. A diet consisting of soft non-irritating food.

A NEW TYPE OF FIXED BRIDGEWORK

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After a consideration of the different types of partial dentures known as either "fixed" or "removable bridgework" and a comparison of their good and bad features, there yet remains a doubt as to just what form of restoration will best meet the requirements of a certain number of typical cases. The following are among the problems to be considered:

(1) What shall be the form of restoration when the four incisors, upper or lower, are absent and there is a marked absorption of the alveolar process?

(2) What should be the procedure when a third molar erupts after the extraction of the bicuspids and molars, this tooth as a rule not being suitable to clasp or bear the strain of a solid fixed bridge?

These and other conditions that might be cited call for a type of restoration which can be kept sanitary, and will not hasten the loss of the abutment teeth, or incite injuries to the tissues, thereby outweighing the advantages gained by the replacement of lost teeth.

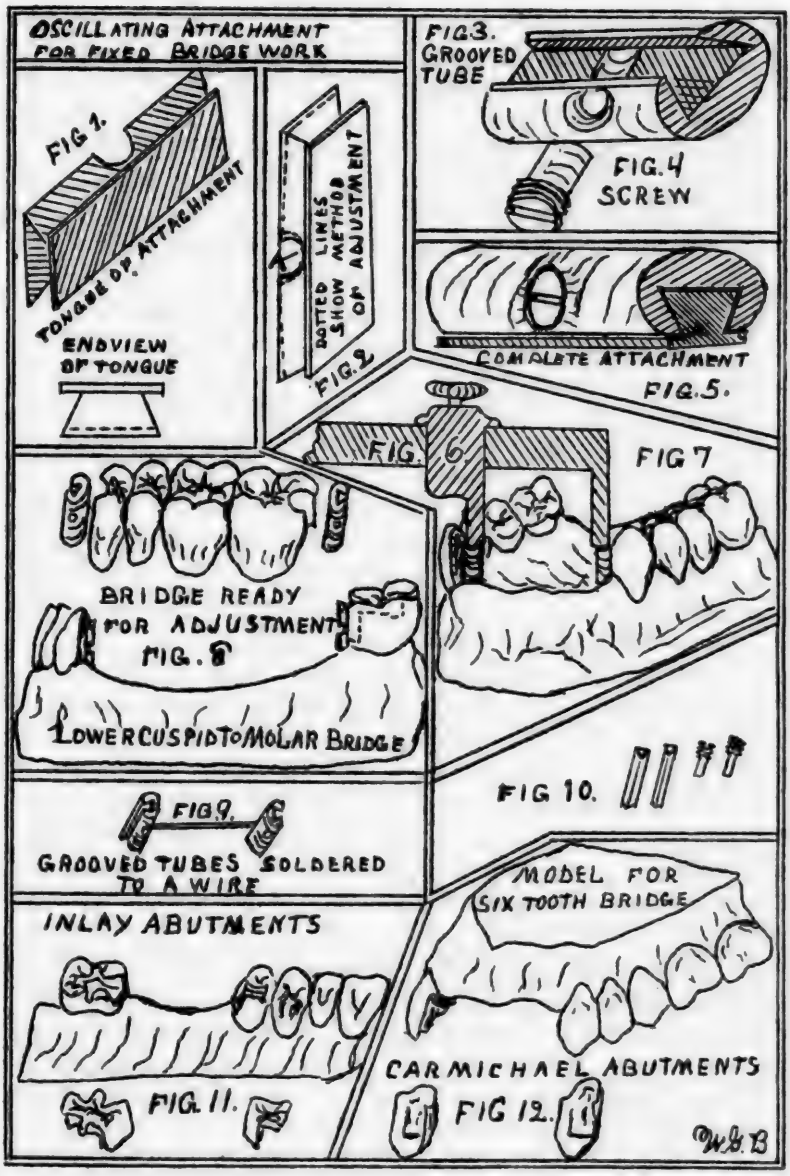
A great variety of devices, offered at the present time, are designated in general "removable attachments." They are intended for use in cases to which reference has been made. The principle is embodied in the tube-and-post type, the tube varying in design from round to oval or half-moon shape. Various means are employed to increase the friction and hold the applicance in place; for example, splitting the post. Lateral and vertical movement are, for the most part, not considered except as a means of removal; and, with one or two exceptions, no effort is made to permit an intermittent pressure on the soft tissues and alveolar process.

The exceptions noted are known as tissue-and-tooth-borne dentures in which consideration is given to the preservation of the health of the tissues of the mouth. Every tooth in a normal mouth has an individual function, the root or roots of each tooth being so formed by nature as best to resist the forces applied in such function. Each tooth is cush-

ioned in its socket by a peridental membrane, and a slight movement is normal and necessary to prevent shock and jar in the act of mastication. Therefore, if artificial teeth in the form of a bridge are attached to these natural teeth without supplying a means for this slight movement, a rigid splint results which is harmful in several ways: (a) two teeth are tied together and made to work as a unit rather than with individual function; (b) inflammation develops, and progresses until deep-seated pathological conditions are evident; (c) occlusal trauma results, which is impossible to remedy and spreads its influence throughout the mouth. These results have been observed after the use of fixed and removable bridgework. Moreover, other and still more harmful effects have occurred from faulty judgment, faulty technic, faulty material, and deliberate disregard for the facts.

To overcome much of this trouble and permit the use of fixed bridgework, without undue strain on abutment teeth, an oscillating attachment has been devised. Its description follows.

The bridge proper may be made in any of the approved types: porcelain or gold, or any combination of the two. The abutments may be of any style heretofore considered satisfactory. The attachment itself is a connecting joint or link between the bridge and the abutment at each end. This attachment consists of three parts; a tongue, a groove, and a screw. The tongue is a triangular shaped rod with an extended edge or apron for easier soldering to the abutment (*figs. 1* and *2*). The groove is a triangular slot through a tube, into which the tongue freely slides without friction (*fig. 3*). The screw is a threaded lock-pin, which prevents these two members from coming apart, but allows limited movement (*fig. 4*). *Fig. 5* shows the three parts of the attachment assembled. In use, the tongue portion is waxed to the abutments, made parallel by means of the parallel rule (*fig. 6*), which has a guide fitting the triangle of the tongue. These abutments, with this part (tongue) of the attachment waxed in its proper position (*fig. 7*), are removed, invested, and soldered. The abutments are cleaned and finished completely, placed in the mouth or back on the model for the adjustment of the central portion of the bridge (*fig. 8*). First, this central portion may have been completed previously or, second, the grooved tubes may be slipped over the tongues, and a wire of exact length waxed between the tubes and then carefully lifted off, invested, and soldered (*fig. 9*). This wire holds



FIGURES 1–12. A NEW TYPE OF FIXED BRIDGEWORK

correct relations while the pontics, of whatever nature, can be built up and finished over it. The grooved tubes in *fig. 8* may be waxed to exact relation on the model or a new relation taken from the mouth, and then soldered to position on the bridge.

It is now possible to vary the adjustment of this attachment to suit the exact conditions of each individual case by filing the tongue as shown by dotted lines in *fig. 2*. The slot *A* in *fig. 2* can be widened up or down to just the extent necessary to distribute that part of the pressure or load of mastication which one's judgment dictates in an individual case. There is no friction, the pressure of mastication is immediately released, and the intermittent stimulation increases the circulation of the tissue beneath. If a saddle is used, a good portion of the load may be carried on the alveolar process. When compression is exerted to the amount desired, the attachment comes to a stop, and the balance of the load is carried on the abutment teeth. It is claimed that constant pressure, as from a partial plate or a clasp-saddle bridge, causes absorption, while an intermittent pressure stimulates circulation and, instead of absorption, induces actual improvement in underlying bone.

This attachment may be readjusted a week, a month, or a year after insertion. It can be separated at any time by the dentist, but not by the patient. It need never be removed unless repair becomes necessary. The material of this attachment is of hard gold to withstand heavy use. It may also be made of a platinum alloy for use in baked-in porcelain work. A very popular field is anticipated with the use of porcelain. Heretofore, because of the possible difficulties and expense of repairs, few have had the courage to undertake this type of highly artistic all-porcelain bridgework. In this bridge, however, with the joint between the abutment and bridge, repair or treatment becomes a simple matter. Porcelain gum-block and tissue-restorative cases, involving surgical measures or replacement made necessary through accident, may be undertaken with absolute confidence.

Fig. 10 shows carbon or cast-iron screws and triangle rods for use while soldering, to prevent the solder from entering the slot or screw holes. *Figs. 11* and *12* are models with cast abutments ready for attachments. This attachment is also of great value as a stress breaker on lingual bar plates or other clasp dentures.

STUDIES OF THE VALIDITY OF ADVERTISED CLAIMS FOR DENTAL INDUSTRIAL PRODUCTS

First Public Report: on "Taxi" and "Stain Remover"[1]

RESEARCH COUNCIL OF THE NEW YORK ACADEMY OF DENTISTRY

WITH THE COLLABORATION OF

CHARLES F. BÖDECKER, D.D.S., F.A.C.D., AND
MAXWELL KARSHAN, M.A., PH.D.

New York City

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I

Abstract of the Council's Findings Relating to "Taxi" and to "Stain Remover"

FOR THE COUNCIL: WILLIAM J. GIES, CHAIRMAN

1. The destructive nature of various advertised tooth-cleaning fluids has been brought to the Council's attention.

2. "Taxi," sponsored by the Holland Specialty Co., Peoria, Illinois, and "Stain Remover," prepared in the Laboratory of Ransom and Randolph Co., Toledo, Ohio, which the manufacturers publicly claim may be used for the removal of stains from teeth without injury to the enamel or gum tissue, have been submitted to careful examination. Reproductions of labels on bottles containing these products are shown in *figs. 1* and *2*.

[1] The findings in this public report were announced at a meeting of the New York Academy of Dentistry, New York City, October 31, 1927.

TAXI

(HOLLAND)

This preparation will remove instantly, without the aid of pumice stone, all green, black, vegetable and nicotine stains from the teeth, positively without injury to the enamel or gum tissue.

DIRECTIONS FOR USE—Insert cotton roll—Moisten pellet of cotton with TAXI. Shake off the excess of liquid and apply to teeth. Wait a few seconds then use brush wheel and stains will decompose and disappear. Rinse patient's mouth with any good alkaline antiseptic.

TAXI removes stains but does not polish teeth. To restore lustre—Use TAXI PROPHALACTIC TABLETS.

You can clean up the foulest mouth in 10 minutes with TAXI. Sold on a positive guarantee to give satisfaction or money refunded.

Price, One Dollar Per Bottle

HOLLAND SPECIALTY CO.

Peoria, Illinois, U. S. A.

Trade Mark Registered in U. S. Patent Office

FIG. 1. TYPOGRAPHICAL REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING "TAXI"

A colored trade figure has been omitted. The type and linear arrangements are substantially although not exactly the same as in the original.

STAIN
REMOVER
A solution for the removal of stains from teeth. Quickly softens tartar, reducing labor of scaling and cleaning
Does not injure enamel or tissue.
DIRECTIONS
Saturate a pellet of cotton and apply to the teeth A large quantity is not necessary to accomplish results. Follow this with brush-wheel or rubber cup.
Prepared in the laboratory of
The Ransom & Randolph Co.
TOLEDO OHIO, U S A

FIG. 2. PHOTOGRAPHIC REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING "STAIN REMOVER"

(See also *fig. 18*, page 499.)

3. Samples of each of these products, bought in the open market, contained large proportions of "strong" mineral acid.

4. Neither product can be applied to teeth, as recommended by the manufacturers, without causing severe destruction of enamel.

5. The claim set forth on the labels of the containers in which these fluids are sold—that each product can be used as stated, without injury to the enamel—is unfounded.

6. Since comparatively simple tests of the products, by their manufacturers, would have shown the injurious character of these fluids, advertisement of this false claim (item 5), with its danger to the public welfare, reveals serious irresponsibility in the producers of "Taxi" and of "Stain Remover."

Opinions of the individual members of the Council

Concurrent: Henry W. Gillett
Arthur H. Merritt
Alfred Owre
Bissell B. Palmer, Jr., Secretary
Leuman M. Waugh

Concurrent, with reservations: None

Nonconcurrent: None

Unrecorded: Holmes C. Jackson (died, October 25, 1927)

Acknowledgment

The accompanying papers, by Referees Charles F. Bödecker and Maxwell Karshan, present some of the scientific data on which these findings are based. The expenses of the scientific phases of this study have been met from current appropriations for the support of research in the Dental and Medical Schools of Columbia University. The Council records its appreciation of this important public service at both schools, and also of the disinterested coöperation of Drs. Bödecker and Karshan.

II

Effects of "Taxi" and of "Stain Remover," So-Called Tooth-Cleaning Fluids, on Dental Enamel[2]

CHARLES F. BÖDECKER, D.D.S., F.A.C.D.

Professor of Dental Histology and Embryology, Dental School, Columbia University, New York City

Introduction

The thorough removal of salivary calculus from the teeth is a tedious and lengthy process, particularly when mouth hygiene has been neglected. Therefore, any agent tending to lighten such a task would be welcomed both by the dentist and the oral hygienist. A number of fluids on the market for this purpose are sold in large quantities to the dental profession. Drug stores also sell to the public various tooth cleaning and whitening agents. In this communication only products sold to the dental profession are considered.

The cleaning fluids used by some dentists perform all that is claimed, and more—they so thoroughly soften tartar that it can be readily removed with a bristle brush in a dental engine, but they also attack enamel to such an extent that, after a single application, the affected surfaces are rendered less resistant to decay. The teeth, enamel as well as dentin, are composed principally of calcium and magnesium compounds. Salivary calculus or tartar has a similar composition. Therefore, any agent that tends to dissolve or soften the one also affects and disintegrates the other. Some acids, particularly the "strong" mineral types, act very energetically in this manner. Strong mineral acids have usually been selected by the manufacturers of tooth-cleaning fluids as ingredients of such preparations.

[2] A preliminary report was read at the fifth general meeting of the International Association for Dental Research, New York City, April 19, 1927. At a clinic given before the First District Dental Society of the State of New York, in December 1925, Dr. W. H. Nitschke made demonstrations of the destructive action of various tooth-cleaning fluids, with results analogous to those reported here.

FIG. 3. PHOTOMICROGRAPH OF A TRANSVERSE SECTION OF A MOLAR SUBJECTED TO THE ACTION OF CLEANING FLUID 1 FOR ONE MINUTE, THE AFFECTED PART BEING MARKED BY A LINE PARALLEL TO THE OUTER SURFACE OF THE TOOTH

The upper plate of enamel shows an appreciable step separating the wax-covered enamel from the affected enamel.

FIG. 4. THE SAME SPECIMEN (FIG. 3) ENLARGED, SHOWING THE DEMARCATION MORE SHARPLY

It is important to note that this tooth had been subjected to the action of *fluid 1* for one minute only.

FIG. 5. SHOWS THE EFFECT OF CLEANING FLUID 2 AFTER ACTING FOR ONE MINUTE ON THE SURFACE OF A CARIOUS TOOTH

The amount of enamel disintegration is large, considering the brevity of the period of contact.

Methods

A number of extracted teeth were selected at random, superficially dried, and their crowns partially covered by longitudinal strips of dental wax. By this means only a part of the enamel was left ex-

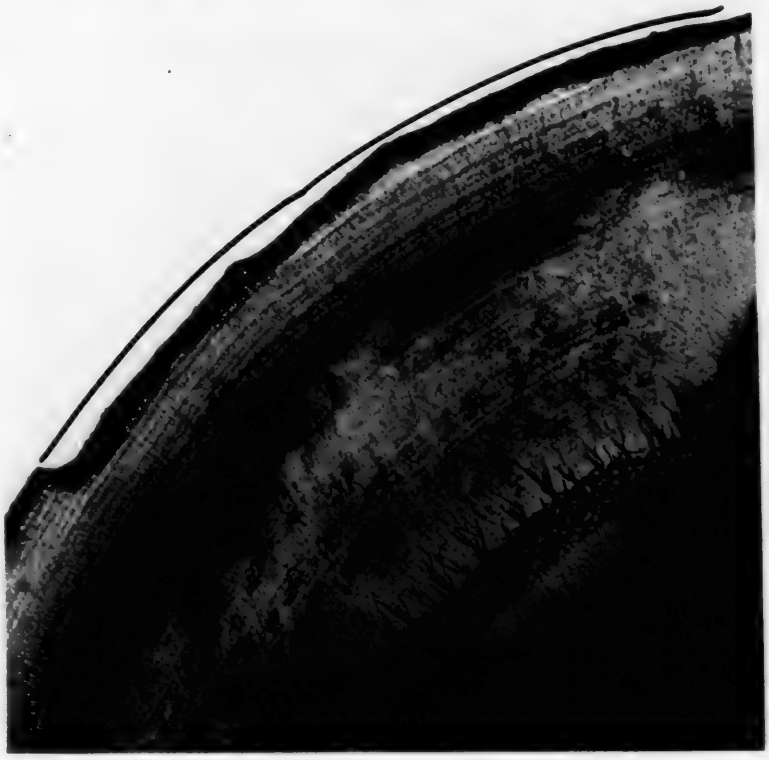

FIG. 6. AN ENLARGEMENT OF A PART OF FIG. 5

posed. Ten teeth, each prepared in this manner, were separately immersed in *fluid 1* or *2*[3] for periods ranging from thirty seconds to

[3] For the sake of brevity and simplicity in description, in this and the succeeding paper, the preparations under examination are designated *fluid 1* and *fluid 2*. *"Fluid 1"* is "Taxi" (Holland Specialty Co.). *"Fluid 2"* is "Stain Remover" (Ransom and Randolph Co.).

nine minutes. The teeth were then immediately placed in a solution of bicarbonate of soda to stop the action of the acid in the cleaning fluid, the wax was removed, and the teeth, after being washed in running water, were immersed in a 5 per cent solution of silver nitrate for fifteen minutes to stain the surface and to show changes in the penetrability of the enamel. Finally, the teeth were sectioned transversely, and the sections, ground fairly thin, where photographed under the microscope to an enlargement of from 10 to 16 diameters.

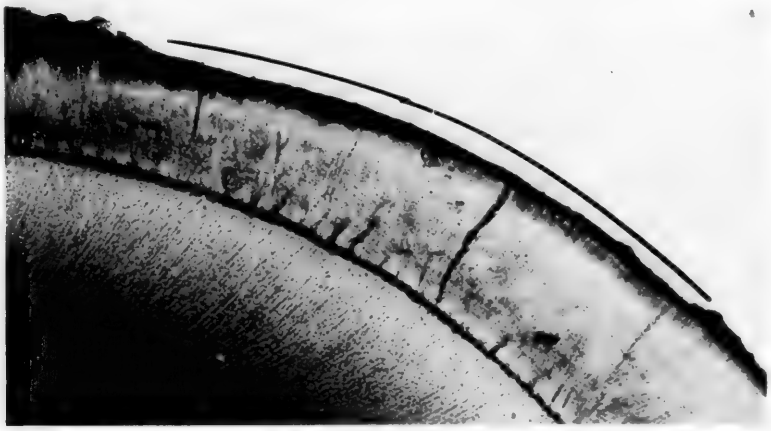

FIG. 7. A SPECIMEN SUBJECTED TO THE ACTION OF FLUID 1 FOR THREE MINUTES

Illustrations of effects

A summary of the legends under the accompanying illustrations is presented to facilitate direct comparisons.

Fig. 3 is a photomicrograph of a transverse section of a molar subjected to the action of cleaning *fluid 1* for *one minute*, the affected part being marked by a line parallel to the outer surface of the tooth. The upper plate of enamel shows an appreciable step separating the wax-covered enamel from the affected enamel. *Fig. 4* is the same specimen (*fig. 3*), enlarged, showing this demarcation more sharply. It is important to note that this tooth had been subjected to the action of *fluid 1* for one minute only. *Fig. 5* shows the effect of cleaning

fluid 2 after acting for *one minute* on the surface of a carious tooth. The amount of enamel disintegration is large, considering the brevity of the period of contact. *Fig. 6* is an enlargement of a part of *fig. 5*.

Compare these effects for *one minute* with the chemical findings for *thirty seconds* (page 497). The most cautious application of a tooth-cleaning fluid, with intent to restrict contact to a limited surface for only a few seconds, cannot prevent undesirable extensions of the period of chemical action. This is not only true of unavoidable delays in removing the fluid but also applies to areas which, by their inaccessibility, retard or prevent prompt removal of the acid mixture, which then may corrode the enamel to the full extent of its destructive power.

Fig. 7 is a specimen subjected to the action of *fluid 1* for *three minutes*.

Fig. 8 shows the marked effect upon a carious tooth after the action of *fluid 1* for *five minutes*. On the treated area, there is not only a striking disintegration of the exposed enamel, but also an increased penetrability to silver nitrate. *Fig. 9* is an enlargement of a part of *fig. 8*. *Fig. 10* shows the effect of a *five minute* penetration of *fluid 2* upon a somewhat carious tooth. *Fig. 11* is an enlargement of a part of *fig. 10*.

Fig. 12 is a non-carious incisor treated with cleaning *fluid 1* for *six minutes*. The disintegration is not so marked as in some of the previous specimens, but is obvious, and must be considered harmful. The right half of the specimen is too thick to allow the ready passage of light, resulting in a darkening of the entire enamel at that side of the picture. *Fig. 13* is an enlargement of a part of *fig. 12*.

Fig. 14 is a slightly carious tooth subjected to cleaning *fluid 1* for *eight minutes*. The agent did not increase the permeability of the enamel to silver nitrate to the degree shown in *figs. 8* and *9*. *Fig. 15* is an enlargement of a part of *fig. 14*.

Fig. 16 is a non-carious tooth subjected to *fluid 2* for *nine minutes*, showing a marked effect. *Fig. 17* is an enlargement of a part of *fig. 16*.

These tests of two of the common tooth-cleaning fluids bring convincing proof that neither product can be safely used in dental practice. Although these agents whiten teeth, they eliminate stains

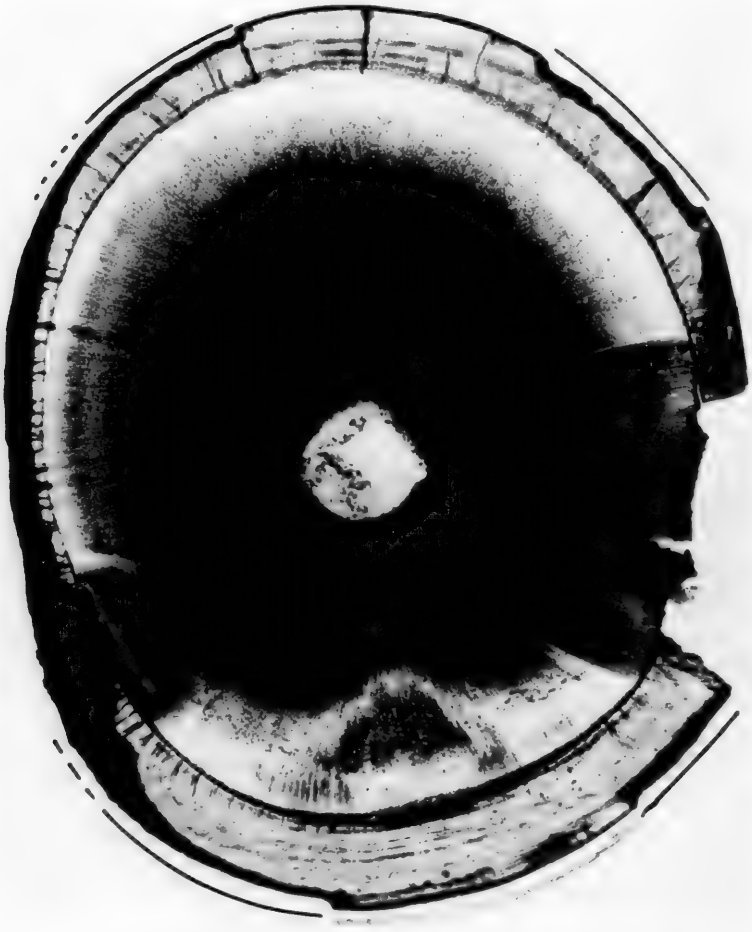

FIG. 8. SHOWS THE MARKED EFFECT UPON A CARIOUS TOOTH AFTER THE ACTION OF FLUID 1 FOR FIVE MINUTES

On the treated area, there is not only a striking disintegration of the exposed enamel, but also an increased penetrability to silver nitrate.

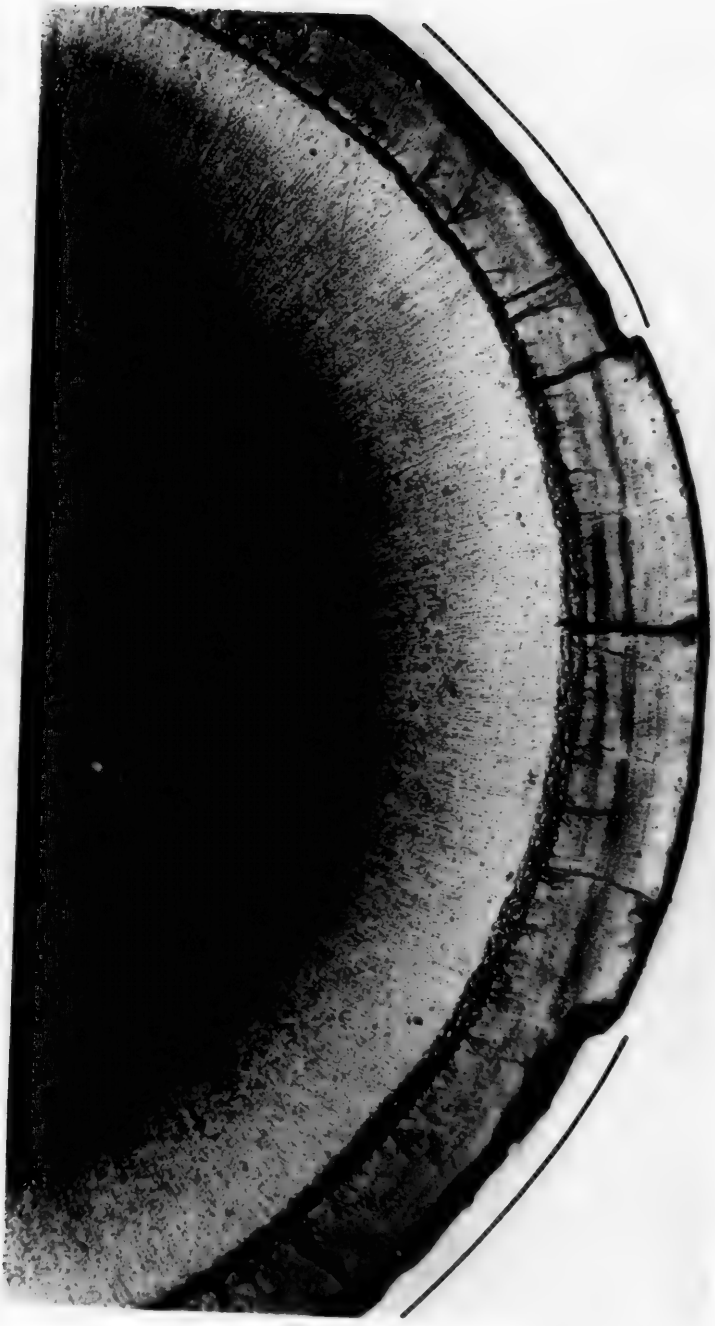

FIG. 9. AN ENLARGEMENT OF THE UPPER PART OF FIG. 8, PLACED VERTICALLY TO GIVE THE MAXIMUM EXTENSION

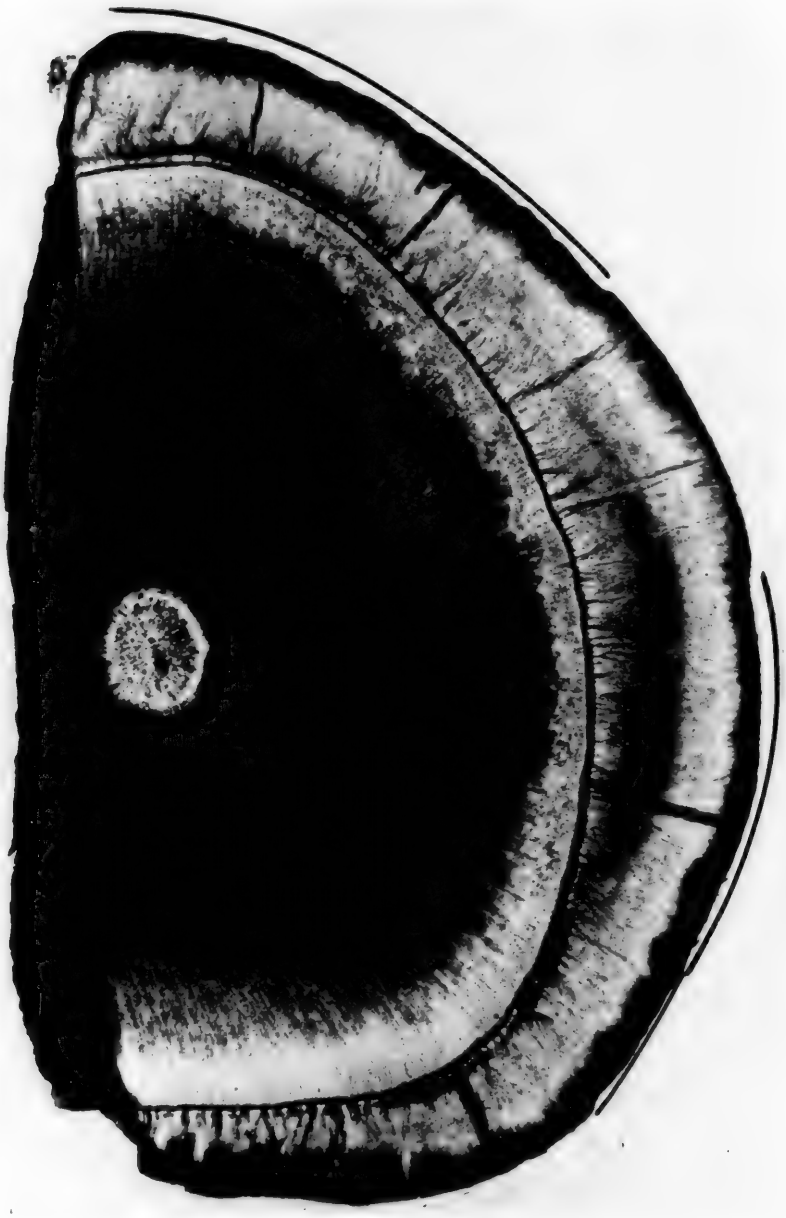

FIG. 10. SHOWS THE EFFECT OF A FIVE MINUTE PENETRATION OF FLUID 2 UPON A SOMEWHAT CARIOUS TOOTH

FIG. 11. AN ENLARGEMENT OF A PART OF FIG. 10

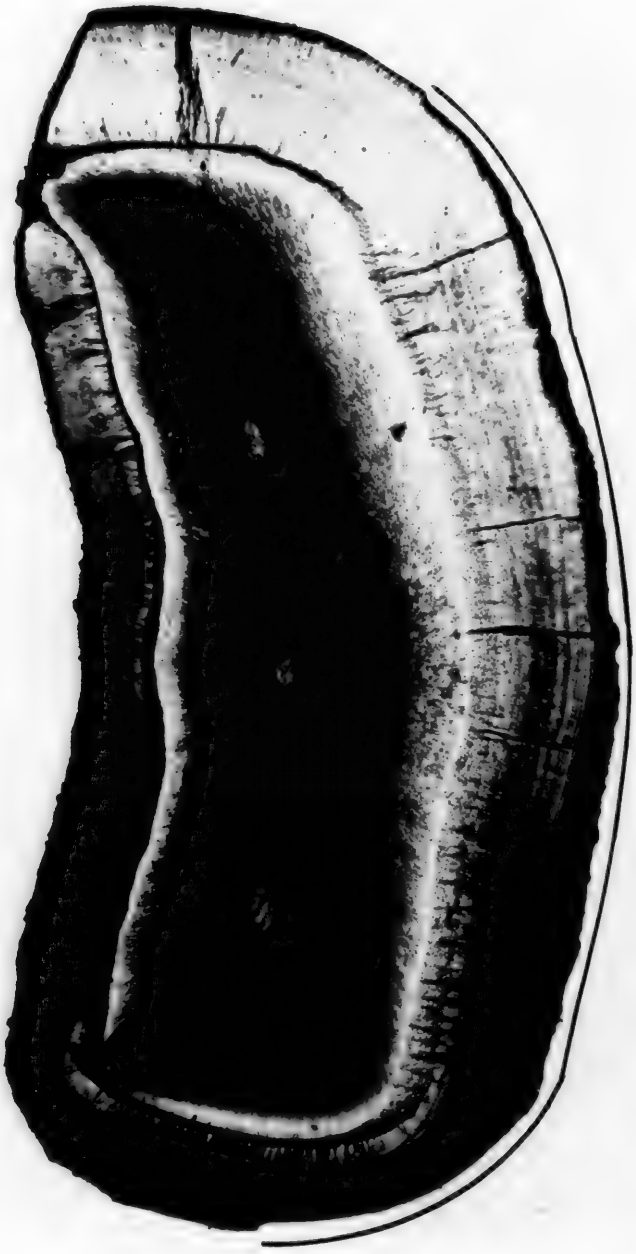

FIG. 12. A NON-CARIOUS INCISOR TREATED WITH CLEANING FLUID 1 FOR SIX MINUTES

The disintegration is not so marked as in some of the previous specimens, but is obvious, and must be considered harmful. The lower half of the specimen is too thick to allow the ready passage of light, resulting in a darkening of the entire enamel at that part of the picture.

by attacking and removing some of the enamel, causing the treated surface to acquire a chalky-white tone. The normal lustre and smooth glaze of the enamel are destroyed, thus refracting more light. But teeth that have been treated in this manner do not long retain their whiteness, for the affected surface of the enamel readily

FIG. 13. AN ENLARGEMENT OF A PART OF FIG. 12

affords attachment for bacterial plaques, thus increasing the tendency to decay. When the cleaning fluid on a cotton pellet is applied to teeth, it does not remain on the labial and buccal surfaces, but, by capillarity, quickly passes to the interproximal surfaces, which, on

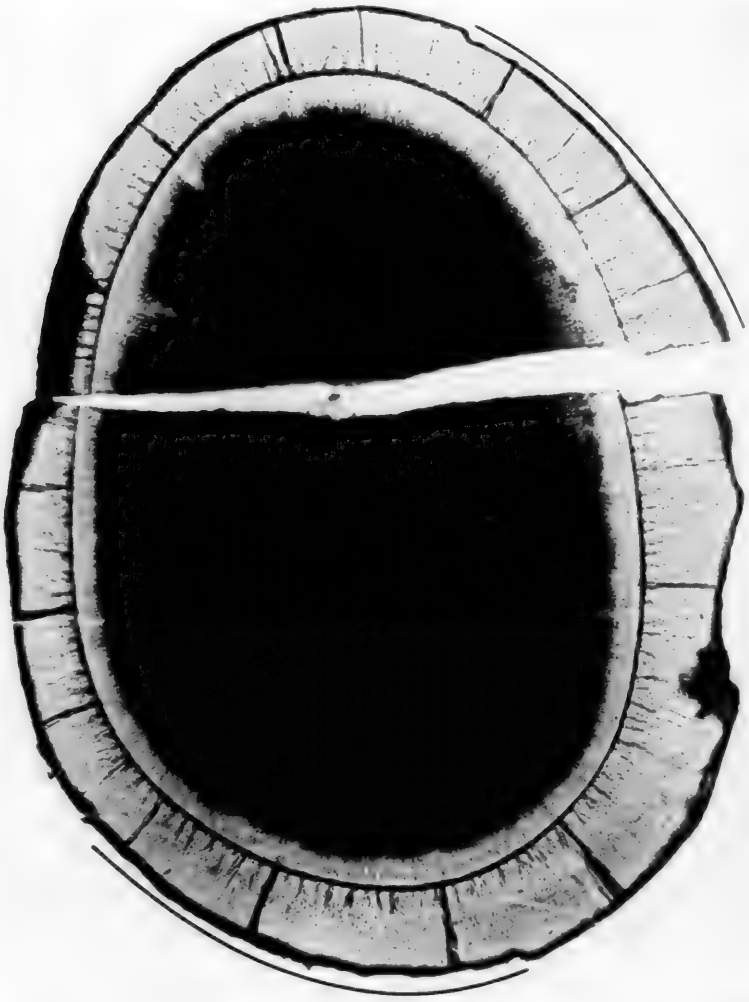

FIG. 14. A SLIGHTLY CARIOUS TOOTH SUBJECTED TO CLEANING FLUID 1 FOR EIGHT MINUTES

The agent did not increase the permeability of the enamel to silver nitrate to the degree shown in *figs. 8 and 9.*

account of their inaccessibility, cannot be well polished and are thus rendered more susceptible to decay.

When these tests were first planned, it was expected that the enamel would show a progressive disintegraton depending upon the length

FIG. 15. AN ENLARGEMENT OF A PART OF FIG. 14

of the period of application. It was believed that a tooth upon which the agent had acted for one minute would show only a shallow dis-

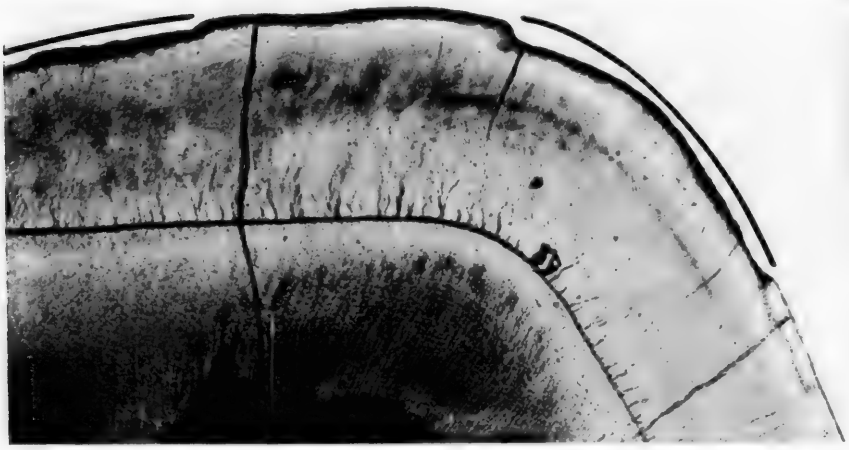

FIG. 16. A NON-CARIOUS TOOTH SUBJECTED TO FLUID 2 FOR NINE MINUTES, SHOWING A MARKED EFFECT

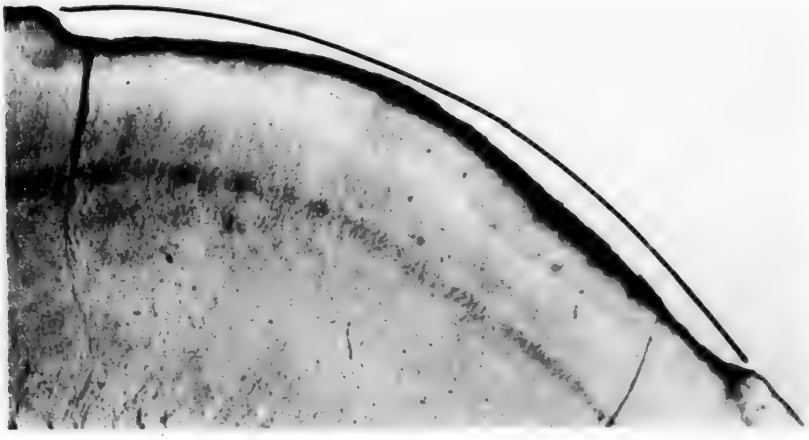

FIG. 17. AN ENLARGEMENT OF A PART OF FIG. 16

integration of the enamel, and that a tooth treated for nine minutes would display a penetration nine times deeper. This, however, was

not the case. In the issue of *Dental Cosmos* for January, 1927, Thurlow and Bunzell published a report on the "effects of acids on tooth tissue." Among their conclusions they state that, "comparing roots and enamel of teeth with so-called hard enamel, with roots and enamel obtained from teeth with so-called soft enamel, we find no distinct difference between the teeth of the two kinds in their behavior towards acids." The accompanying illustrations (*figs. 3–17*) of specimens subjected to the action of cleaning fluids show decided variations in the depth of penetration. This difference is so marked that the tooth in *fig. 5*, on which *fluid 2* acted for only one minute, shows as deep a disintegration of the enamel as the tooth in *fig. 10*, which was subjected to the action of the same fluid for five minutes.

This apparent contradiction may be due to prompt partial or complete neutralization of the acid by basic salts in the enamel; also to variations in the quality of the enamel on the teeth of different individuals, a matter of considerable importance, for it may throw some light upon susceptibility and immunity to dental caries. Our knowledge of the enamel is limited as yet, and it is therefore difficult to say what differences in this tissue account for its variable resistance to the action of acids. It may be due to variations in the chemical constitution of enamel. Much research is required to fathom this problem. In the near future I hope to report the results of some tests of these possibilities that are now in progress.

Conclusions

Fluids 1 and *2*, now extensively used by some dentists to facilitate the cleaning of teeth, are decidedly destructive of the enamel.

Microscopic specimens prepared from teeth subjected, for from one-half to nine minutes, to the action of either fluid show that these agents achieve their cleansing action by disintegrating the surface of the enamel.

Teeth cleaned with *fluid 1* or *fluid 2* become decidedly more susceptible to dental caries owing to the increased tendency of bacterial plaques to cling to the surfaces corroded by these agents.

Therefore the use of these fluids in dental practice is contraindicated.

III

The Acidity of "Taxi" and of "Stain Remover," So-Called Tooth-Cleaning Fluids[4]

MAXWELL KARSHAN, M.A., PH.D.

Assistant Professor of Biological Chemistry, Dental School, Columbia University; Biochemical Laboratory, College of Physicians and Surgeons, New York City

Methods

In a chemical study of *fluid 1* and *fluid 2*, the nature and degree of the acidity were ascertained. The hydrogen-ion concentration was determined electrometrically. Having found the ordinary electrometric method involving the hydrogen electrode unsuitable for these fluids, the quinhydrone electrode, described by La Mer and Parsons,[5] was employed. The titratable acidity of *fluid 1* was determined by "neutralizing" 5 cc. of fluid with 0.1 N sodium hydroxide solution, using as indicators methyl orange, phenolphthalein, and litmus paper. Although close checks were obtained, litmus paper, owing to the initial color of the fluid, is the more efficient indicator. The large amount of ammonium salt in *fluid 2* made it desirable to conduct the titrations of this liquid with methyl orange as the only indicator. The kinds of acid present were established by ordinary qualitative tests.

Results for fluid 1

The acid present in *fluid 1* was chiefly hydrochloric acid. The pH was 0.07, which is equivalent to a hydrogen-ion concentration of 0.85 N. In the titrations, 5 cc. of the fluid required 57.1 cc. of 0.1 N sodium hydroxide solution, indicating an acidity of 1.1 N. The percentage strength of the acid, expressed in terms of hydrochloric acid and calculated from the hydrogen-ion concentration, was 4.0.

[4] A preliminary report was read at the fifth general meeting of the International Association for Dental Research, New York City, April 19, 1927.

[5] La Mer and Parsons: *Journal of Biological Chemistry*, 1923, lvii, p. 613.

Results for fluid 2

The acid present in *fluid 2* was chiefly hydrochloric acid. The presence of fluoride in this liquid accounts for the presence of some hydrofluoric acid (by hydrolysis). The pH was 0.017, which is equivalent to a hydrogen-ion concentration of 0.97 N, slightly greater than that found for *fluid 1*. In the titration tests, 5 cc. of the fluid required 63.0 cc. of 0.1 N sodium hydroxide solution, indicating an acidity of 1.3 N. The percentage strength of the acid, expressed in terms of hydrochloric acid and calculated from the hydrogen-ion concentration, was 4.8.

Summary

SOLUTION	pH	H-ION CONCENTRATION	CC. OF 0.1 N NaOH TO NEUTRALIZE 5 CC. OF FLUID	CALCULATED NORMALITY OF ACIDITY	PERCENTAGE STRENGTH EXPRESSED IN TERMS OF HCl
Fluid 1	0.070	0.85 N	57.1	1.1	4.0
Fluid 2	0.017	0.97 N	63.0	1.3	4.8

Solvent action on enamel

The uninjured crown of a human molar, the roots of which were embedded in wax, was moistened with water and the occlusal surface immersed for thirty seconds in 2 cc. of *fluid 1* in a thin layer in a porcelain crucible. Conventional tests applied to the fluid gave striking responses for both calcium and phosphate, showing that considerable material had been removed from the enamel as a result of this treatment. Control tests of the liquid itself under the same conditions, gave negative results for phosphate, and a faint response for calcium.

The experiment was repeated for *fluid 2*, with similar results.

IV

Editorial Note

The *Journal of Dental Research* is authorized to state that the Research Council of the New York Academy of Dentistry invites dentists, and all who may be interested, to aid in the detection and

public exposure of fraud, deception, or irresponsibility in the production, advertisement, or distribution of dental industrial products. Each problem, as it arises, will be carefully studied, under the auspices of the Council, by one or more competent and disinterested referees. Correspondence may be addressed to the New York Academy of Dentistry, to the Council, to any member of either, or to this *Journal* for the Council.

The *Journal of Dental Research* will publish the Research Council's reports, which, in whole or in part, may be reprinted without restraint. This *Journal's* copyright on these reports will be waived unconditionally.—[*Ed.*]

V

Addendum

Comment by the manufacturers of "Taxi" and "Stain Remover"[6]

On November 4, 1927, copies of a provisional draft of the foregoing findings and reports were forwarded to the manufacturers directly concerned, for their information and to afford opportunity "to express any opinion or to add any information which would be of interest to the Council." With the consent of the writers, the replies to this invitation are appended.

1. A portion of the reply by F. G. Crandell, President of the Ransom and Randolph Company, Toledo, Ohio, November 11, 1927

....At least during a period of the last preceding three years no claims have been made either on the label, in catalogues, or in clinic demonstrations that our stain remover is not injurious to tooth structure or gum tissue. As evidence of this we enclose a sample of the label that we have been using for at least that long (*fig. 18*).

2. Reply by M. J. Holland, the Holland Specialty Company, Peoria, Illinois, November 12, 1927

We are in receipt of your letter of November 4th, regarding our preparation Taxi and its use by the dental profession. We note that

[6] The manufacturers of these products have received replies, from the Research Council, which, they have been informed, they are free to publish in this *Journal* or elsewhere.

in making your experiments with Taxi that teeth were subjected to its action for periods ranging from one-half minute to nine minutes. We are much puzzled to know how you figure subjecting extracted teeth for periods ranging from one-half minute to nine minutes completely immersed in Taxi as a test has anything to do with the manner in which we advocate Taxi being used in the mouth.

Under no circumstances or conditions are the natural teeth in the mouth subjected to any such test as this; and when we say that Taxi

R & R
STAIN REMOVER
A solution for the removal of stains from teeth. Quickly softens tartar, reducing the labor of scaling and cleaning.
Contains the following ingredients:
Distilled water, Thymol, Cochineal (for color), Ammonium Fluoride, and other agents.
DIRECTIONS
Saturate a pellet of cotton and apply to teeth. A large quantity is not necessary to accomplish results. Follow this with brush-wheel or rubber cup.
Prepared in the laboratory of
The Ransom & Randolph Co.
TOLEDO, OHIO, U. S. A.

FIG. 18. TYPOGRAPHICAL REPRODUCTION OF THE LATEST FORM OF THE LABEL ON BOTTLES CONTAINING "STAIN REMOVER." (COMPARE WITH FIG. 2)
A very close duplication in all respects excepting color

is not injurious to the enamel, we naturally assume that a dentist knows we mean it is not injurious when used according to directions. Those directions are: "Apply to the teeth, wait a few seconds and use brush wheel." A small amount thus applied to the tooth is neutralized before any appreciable injurious action has taken place. We do not say to a dentist, "Have the patient take a mouth full of Taxi and retain this in the mouth from one-half minute to nine minutes," as you have done in making your test.

We suggest that you take extracted teeth, immerse them in Heinz's

Vinegar, Grape Juice and Lemon Juice and note what happens and after ascertaining these results, you might be justified in having your Research Council try to stop the use of the aforesaid articles. There are hundreds of drugs prescribed by physicians today that are perfectly safe when used in moderation but when used to excess cause untold damage.

In Paragraph 4,[7] you state that Taxi cannot be applied to the teeth without causing severe destruction of the enamel. This is not true. It can be applied and is being applied every day in the manner recommended by us without severe destruction of the enamel.

Paragraph 6[7] is untrue in its entirety. We are producing Taxi because we have a demand for it. *The very profession for whom you claim to be making a research demands this preparation and we are supplying that demand,* the same as a druggist supplies arsenic, cocain or anything else that the public demands; and it does not indicate an irresponsibility on the part of the manufacturer, when he is in business to give people what they want. [Italic not in the original.]

We note that there are five members of your Council that have agreed that Taxi is injurious. Against these five members of your Council, we submit *at least 50,000 dentists who are using Taxi* and a large percentage of whom are as well versed in medicine and other things pertaining to their profession as the five members of your Council. By what right, we ask, do these five men set up their opinion against the vast majority of the dentists, who consider Taxi all right when used according to directions? [Italic not in the original.]

In conclusion we wish to say that we do not consider immersing a tooth in a solution for periods from one-half to nine minutes is comparable in any way to the manner in which we recommend Taxi being used in the mouth. We wish to reiterate that *the profession demands Taxi and we are supplying that demand.* If you feel that they should not use it, *why not educate them to your ideas?* Now, as you state you are going to publish your ideas of Taxi, if you wish to be fair in the matter and not make your article a one-sided affair, why not publish our letter and let the profession judge for themselves? [Italic not in the original.]

[7] This refers to the numbered paragraph on page 479.

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SUPPLEMENT

I. REPORT OF THE REPRESENTATIVES OF THE FIRST DISTRICT DENTAL SOCIETY OF THE STATE OF NEW YORK IN THE HOUSE OF DELEGATES OF THE AMERICAN DENTAL ASSOCIATION: 1927

THEODOR BLUM, JOHN T. HANKS, W. A. SQUIRES, AND MARTIN DEWEY

The sixty-ninth annual session of the American Dental Association, held at Detroit, October 24–28, 1927, was a highly successful meeting. The attendance was large, the clinics and section lectures were well attended, and the technical exhibit was one of the best that the Association has had in many years. Exhibition Hall, in the General Motors Building, was an ideal place for an exhibit of this kind. The meetings of the House of Delegates were held at the Book-Cadillac Hotel. We wish to compliment President Banzhaf for his ability, efficiency, and fairness as the presiding officer.

A meeting of the delegates from the Dental Society of the State of New York was held at the Book-Cadillac Hotel, on Monday afternoon, October 24, 1927. Most of the state delegates were present. At that meeting a policy was decided upon which included the introduction of a resolution to decrease the dues of the American Dental Association from four to three dollars per year. However, action on all resolutions regarding the increase or decrease of dues must be postponed for one year. This resolution was introduced because over $600,000 has accumulated in the treasury of the American Dental Association, and there seems to be no immediate need for any larger amount until some definite policy is decided upon. However, after the introduction of the above mentioned resolution, the Board of Trustees decided to take $20,000 from the general fund and apply it to the Permanent Relief Fund. The interest from this fund is to be used for "dental relief."

The New York delegation discussed the advisability of introducing a resolution requesting the Board of Trustees to effect a plan whereby the *Journal of the American Dental Association* would be published semi-monthly instead of monthly. President Banzhaf recommended such a plan in his presidential address, which was later favored by the Committee on Officers' Addresses; and a resolution was passed by the House of Delegates instruct-

ing the Board of Trustees to place the *Journal of the American Dental Association* on a semi-monthly basis as soon after January, 1928, as possible. This plan will require a rearrangement of contracts with advertisers, and your delegates doubt whether it will be possible for the Board of Trustees to bring about the proposed change before 1929. However, we believe that the *Journal of the American Dental Association* should be a semi-monthly publication, and the official organ of all state and component dental societies. The House of Delegates also voted to discontinue the publication of the *Dental News* with the next issue, when four numbers will have appeared. This publication was discontinued in order to add the money required for its publication to the *Journal* fund for semi-monthly publication. If the *Journal of the American Dental Association* is made a semi-monthly publication it may be advisable to withdraw the resolution to reduce the dues to three dollars.

The New York delegation was recognized by the President of the American Dental Association by the following appointments: Dr. John T. Hanks was appointed a member of the Committee on Credentials, and Dr. Martin Dewey was appointed chairman of the Committee on Miscellaneous Business.

At the last meeting of the House of Delegates in Philadelphia (1926), Dr. Ottolengui introduced a resolution that Section IX of the New York State code of ethics, which was passed by the Executive Council of the Dental Society of the State of New York, be reconsidered by the Judicial Council at a special hearing and then reported to the House of Delegates for action. The action of the Judicial Council was to be referred to the House of Delegates for action without reference to any other committee. At the first meeting of the House of Delegates in Detroit, the chairman of the Judicial Council, Dr. G. Walter Dittmar, introduced a new code of ethics for the American Dental Association, which did not contain Section IX of the New York State code of ethics. Dr. Dittmar stated that a hearing on Section IX of the New York State code of ethics would be held on Tuesday afternoon. At that hearing, Dr. Ottolengui and Dr. Gillett appeared in favor of Section IX, and Drs. Blum, Hanks, and Dewey of New York, and Dr. Tanzey of Missouri, spoke against it. At the Wednesday meeting of the House of Delegates, the chairman of the Judicial Council moved that the code of ethics reported on Monday be made the code of ethics of the American Dental Association, with the instruction that each state society adopt the same. The House of Delegates approved this action.

At the meeting of the American Dental Association at Louisville (1925), Dr. John T. Hanks introduced a standing resolution whereby it was made obligatory that the officers and chairmen of the various committees and

commissions formulate a budget, to be printed and presented at one meeting of the House of Delegates for action at a subsequent meeting. This plan was intended to give the House of Delegates sufficient time to study the budget, and to obtain definite knowledge of the amount of money in the treasury and how it was proposed to be spent. At Philadelphia (1926), the budget was not presented until the last meeting of the House of Delegates, and was read but never printed. The delegation from the First District Dental Society criticized that action in their report of last year.[1] As a result of this and similar criticisms, the Secretary of the American Dental Association called the attention of the Board of Trustees, at the May meeting, to the fact that the standing resolution stated that the budget must be printed and presented to the House of Delegates for their approval. Dr. Banzhaf also stated at various times during his administration the necessity of having a budget prepared in advance. This year the budget was presented to the House of Delegates on Wednesday for their action on Thursday.

Dr. Banzhaf in his annual address to the House of Delegates, and Dr. King, the Secretary, called attention to the work of the Department of Dental Health Education, and recommended a substantial increase in the appropriation. The budget presented by the Trustees gave the Department of Dental Health Education $10,000. This was an increase of only $2,000 over the previous year. As a result of the fact that the budget was presented on Wednesday, the First District Delegation was able to study the matter and decided that the Department of Dental Health Education should have a larger appropriation, because of the wonderful work done by Miss Evelyn C. Schmidt and her associates. An increased appropriation was possible because the budget showed a contingent fund of $22,000. Dr. Hanks moved that the Department of Dental Health Education be given $5000 more. The motion was seconded and unanimously passed.

The various meetings of the delegates of the New York State Society culminated in a dinner at which the delegates of the New York State Society were guests of the delegates of the First District Dental Society. President Banzhaf, President-elect Volland, and Trustee Lum were also guests at the dinner.

The House of Delegates appropriated $13,500 to complete the work of the Dental Index. A resolution was introduced requesting the Board of Trustees to present a plan for redistricting the United States into thirteen districts, instead of nine, in order to elect thirteen trustees as provided by

[1] Blum and Dewey: *Journal of Dental Research*, 1926, vi, p. 481.

the Articles of Incorporation. When the American Dental Association was organized and incorporated, the United States was divided into nine districts instead of thirteen. In years past nine districts have elected one trustee from each district, and the president, president-elect, secretary, and treasurer had been made *exofficio* members to complete the thirteen districts as called for in the Articles of Incorporation. It is the belief of your delegates that such a plan was never intended by the Articles of Incorporation, and is furthermore unfair because it usually gives four of the nine districts two trustees each when each district should have but one. The plan of redistricting seemed to be taken very favorably by a majority of the House of Delegates, but was frowned upon by the officers in control; as a result, the Board of Trustees did not present the plan for redistricting at the time requested, and begged the House of Delegates to give them more time, which was granted. This proposition will be held over until the next meeting of the American Dental Association.

Resolutions were introduced outlining the standing of life members in the American Dental Association and dealing with the transfer of members of the American Dental Association from one state to another. These resolutions were laid over for action until next year.

President Banzhaf, in his annual address to the House of Delegates, made a plea for the formation of a National Board of Dental Examiners, copied after the plan of the National Board of Medical Examiners. That question was referred to the Committee on the Constitution and Administrative By-Laws. The report of this committee was laid on the table until next year. Many of the members of the House of Delegates were in favor of a National Board of Dental Examiners, but did not agree with the President's plan of organization.

The following general officers were elected: *President*—R. H. Volland, Iowa; *President-elect*—Percy R. Howe, Massachusetts; *General Secretary*—Harry B. Pinney, Illinois; *Treasurer*—A. R. Melendy, Tennessee.

II. NOTES FROM THE MINUTES OF THE EXECUTIVE PROCEEDINGS OF THE NEW YORK ACADEMY OF DENTISTRY: 1926–27

MALCOLM W. CARR, D.D.S., *Editor*

OFFICERS

President—Bissell B. Palmer, Jr.; *Vice-president*—William D. Tracy; *Secretary*—S. E. Davenport, Jr.; *Treasurer*—Alfred L. Kohn; *Editor*—Malcolm W. Carr.

Executive Committee: Leland Barrett, Leuman M. Waugh, Joseph Eby, Chairman.

Fellowship Committee: William B. Dunning, Harold S. Vaughan, Sebert E. Davenport, Chairman.

SCIENTIFIC MEETINGS

During the season of 1926–27, the New York Academy of Dentistry held six monthly meetings at the Commodore Hotel, New York City, which were preceded by informal dinners.

October. A practical prosthetic symposium was presented by four essayists, on the following topics: "Modeling-compound impressions for full-denture construction," by Dr. Martin Collins, for Dr. Edward Kennedy; "Bite-taking with the Gysi Gothic Arch Marker," by Dr. Russell W. Tench; "Articulation with the Hanau Articulator," by Dr. Victor Sears; and "Esthetics," by Dr. James P. Ruyl.

November. Louis I. Harris, M.D., Commissioner of Health of the City of New York, addressed the Academy on "the relation of the dental profession to public health."[2] The discussion was opened by Michael M. Davis, Jr., Ph.D., Chief of the Service Bureau on Dispensaries and Community Relations of the Hospitals of the American Hospital Association, and continued by William P. Healy, M.D., President of the New York County Medical Society, and Henry W. Gillett, D.M.D., F.A.C.D., Past-president of the New York Academy of Dentistry.

January. John E. Nyman, M.D., D.D.S., of Chicago, Illinois, presented a paper entitled "Immunity and susceptibility to systemic involvement from focal infection."[3] The discussion was opened by Judson Daland, M.D., of Philadelphia, Pa., and continued by Herman J. Kauffer, D.D.S., of New York City.

February. William J. Gies, Ph.D., F.A.C.D., delivered an address entitled: "An analysis of the conclusions of the Carnegie Foundation's study of dental education."[4] The discussion was opened by LeRoy M. S. Miner, M.D., D.D.S., Dean of the Harvard Dental School, and continued by Bissell B. Palmer, Jr., D.D.S., President of the New York Academy of Dentistry.

March. The second annual series of progressive table clinics was pre-

[2] Harris: *Journal of Dental Research*, 1927, vii, p. 213.

[3] Nyman: *Ibid.*, p. 285.

[4] Gies: Dental Education in the United States and Canada (1926); Bulletin Number Nineteen, Carnegie Foundation for the Advancement of Teaching, New York City. Published June 27, 1927.

sented as follows: "Heat treatment of elastic golds," by Dr. Leo G. Pollock; "Fillings of pits and fissures with gold foil," by Dr. W. D. Tracy, for Dr. LeRoy L. Hartman; "Preparation of vital molar teeth for porcelain jacket-crowns," by Dr. Carlisle C. Bastian; "An exact reproduction of set-up for full upper and lower sets of teeth," by Dr. H. Kroehl Taylor; "Stereopticon illustrations of incipient mouth lesions," by Dr. Paul R. Stillman; "Laws governing round-wire clasp design," by Dr. Henry W. Gillett; and "Preparation, working models, and finished specimens of shoulder jacket-crowns," by Dr. William A. Squires.

April (annual meeting). Frederick S. McKay, D.D.S., Chairman of the Committee on Mottled Enamel Research, gave a brief presentation of the latest investigations and developments in his work on mottled enamel. William J. Gies, Ph. D., F.A.C.D., outlined and discussed the prospective program and work of the Research Council of the New York Academy of Dentistry. Reports of officers and committees were presented, and the following officers elected for the ensuing year: *President*, Arthur H. Merritt; *Vice-president*, Leuman M. Waugh; *Secretary*, S. E. Davenport, Jr.; *Treasurer*, Alfred L. Kohn; *Editor*, Malcolm W. Carr.

Five Associate Fellows, Drs. Herbert S. Bailey, Carlisle C. Bastian, Frederick H. Brophy, Joseph H. Jaffer, and William A. Squires, were elevated to active fellowship in the Academy in recognition of achievement and distinction in professional activities.

BANQUET

A testimonial banquet, under the auspices of the New York Academy of Dentistry, was tendered to Professor William J. Gies, on April 19, at the Hotel Plaza in New York City, in recognition of the distinct service which he had rendered the dental profession by his study of dental education under the auspices of the Carnegie Foundation for the Advancement of Teaching. Dr. Bissell B. Palmer, Jr., President of the Academy, introduced Dr. Henry W. Gillett, Past-president of the Academy, as Toastmaster, who presented the following speakers: Dr. Henry L. Banzhaf, President of the American Dental Association, on "Life's greatest privilege;" Mr. Newcomb Carlton, Trustee of Columbia University, on "Universities and public service;" and Dr. Frederick P. Keppel, President of the Carnegie Corporation, on "Foundations, universities, and professions." Responses were made by Professor Gies and Mrs. Gies.

RÉSUMÉ OF EXECUTIVE PROCEEDINGS

The president of the Academy, Dr. Bissell B. Palmer, Jr., presented the following resolution:

"*Whereas*, if all members of the dental profession limited their professional activities to their own offices, dentistry as a profession would still be in its elementary stage of development; and

"*Whereas* the present advanced state of the profession is due entirely to research, teaching, and reporting of improvements in technology; and

"*Whereas* the dental profession must continue its advance and increase its usefulness and service to humanity; and

"*Whereas* one of the principal objects of the New York Academy of Dentistry is to encourage the younger members of the profession to be active in the various fields tending to advance dentistry; and

"*Whereas* activity in any such field of advancement leads to Active Fellowship in the Academy; therefore be it

"*Resolved* that the New York Academy of Dentistry establish an Activities Bureau, which shall serve as a clearing house between Associate Fellows desiring to engage in professional activities, and institutions having openings for such Fellows of the Academy."

The resolution was unanimously adopted by the Academy, the Bureau of Activities established, and the following committee appointed to direct the operation of the several divisions of activity of the Bureau: Charles F. Bödecker, dental research; William J. Gies, dental journalism; Arthur H. Merritt, dental clinics; Leuman M. Waugh, dental teaching; Bissell B. Palmer, Jr., Chairman, dental organization. To each Fellow of the associate group there was addressed a questionnaire asking for an indication of the particular activity in which he preferred to participate. All of the Fellows who signified their desire to become thus identified with a branch of professional activity were given the opportunity of placement during the year.

The establishment of a Research Council of the New York Academy of Dentistry was proposed by Dr. Bissell B. Palmer, Jr., and presented for the Academy's consideration, as follows:

"*The situation.* At the present time the dental profession and the public which it serves are not safeguarded against worthless and even harmful dental preparations and apparatus. The medical profession is so protected by a committee of the American Medical Association known as the Council on Pharmacy and Chemistry.

"*The proposed remedy:* The organization of a committee to be known as the 'Research Council of the New York Academy of Dentistry.' This Council would ascertain by research the correctness and accuracy of the advertised claims of the manufacturers of dental products.

"*Recommended method of organization of the Council.* The New York Academy of Dentistry, following the adoption of this general proposal, would invite Dr. William J. Gies, an Active Fellow of the Academy, to accept appointment as Director of the Council

for a term of seven years. He would be requested to name the other six members of the Council, who would serve for various terms, from one to six years, as determined by lot. Each year in April, at the time of the annual meeting of the Academy, the six members of the Council having unexpired terms would elect the seventh member for a period of seven years. Thus the Council would become a self-perpetuating body.

"*Rules and regulations.* The Council would formulate its own rules and regulations, which could be revoked by a three-fourths vote of the Board of Governors followed by a three-fourths vote of the total active fellowship of the Academy.

"*Finances.* The work of the Council would be financed by the Advancement Fund of the Academy, and by contributions made directly to the Council for its work.

"*Publication of findings.* The New York Academy of Dentistry would have full ownership of the publication rights of the investigation results of the Research Council, but the Council would have full charge of the editing and actual publication of these findings. The reports of the Council would be published in the *Journal of Dental Research.*"

The proposal was unanimously adopted by the Academy. Professor Gies accepted appointment as Director of the Council and at the April meeting announced, as the other six members of the Council, the Past president, the President, the President-elect, and the Vice-president-elect, of the Academy, and the deans of the two dental schools in New York City, namely, Henry W. Gillett, Holmes C. Jackson, Arthur H. Merritt, Alfred Owre, Bissell B. Palmer, Jr., and Leuman M. Waugh. The Academy evidenced hearty endorsement of these selections. (The Research Council's first report is published on page 477 of this issue.)

The President of the Academy, Dr. Bissell B. Palmer, Jr., proposed the establishment of a "dental center" in New York City. The suggestion was approved by the Board of Governors of the Academy, and the following Committee was appointed to consider the matter: William J. Gies, Arthur H. Merritt, and Bissell B. Palmer, Jr., Chairman.

III. REPORT OF THE COMMITTEE ON DENTAL EDUCATION OF THE ASSOCIATION OF AMERICAN UNIVERSITIES: 1926[6]

HUGH CABOT, *University of Michigan;* W. A. JESSUP, *University of Iowa;* LEROY M. S. MINER, *Harvard University;* ALFRED OWRE, *University of Minnesota;* WILLIAM J. GIES, *Carnegie Foundation for the Advancement of Teaching, Chairman*

A

Each of the members of this Committee has had an opportunity to examine a copy of the confidential page proof of the Carnegie Foundation's

[6] Reprinted from the *Journal of the Proceedings and Addresses of the Association of American Universities*, Twenty-eighth Annual Conference, Northwestern University, Chicago, November 11–13, 1926; published in 1927, pp. 35–36.

"*Bulletin on Dental Education.*" The *Bulletin*, which is now in press, indicates in detail the present condition of the dental schools, and presents the findings of a prolonged study of dental education in the United States and Canada. It would seem, therefore, that a comprehensive report by this Committee or by its successor might suitably be postponed until the next annual meeting, when all of the Foundation's conclusions could be considered, and it would be more opportune to present the Committee's independent recommendations.

B

Several matters of general import warrant the special interest of this Association in the promotion of dental education. Disorders of the teeth and closely adjacent tissues, and the ensuing maladies, are among the most common disabilities. Dentistry, an important means to prevent these ailments and to cure them or to alleviate their effects, is primarily *health service*. Dentistry has been legally established as a separate profession. There are now about seventy-five thousand licensed practitioners of dentistry, and forty-seven dental schools, in the United States and Canada. Of these dental schools, forty are university schools, three are members of groups of professional schools, and four are independent. Of the latter, two are proprietary. Some of the most useful dental schools are integral parts of universities holding membership in this Association.

C

The present academic year [1926–27] is notable in the history of dental education as the first in which, for dental schools in the United States, an entrance requirement of at least one year of approved work in an accredited academic college became a prerequisite for the Dental Educational Council's Class A or Class B rating. In 1925-26 graduation from a high school continued to be the minimum entrance requirement in sixteen dental schools. Now the Dental School of the University of California and the proprietary Texas Dental College (Houston) are the only dental schools in the United States and Canada that do not require at least one year of approved work in an accredited academic college for admission or include it as the first year in a five-year combination of academic and professional curricula.

The spirit behind this general forward movement in the dental schools is clearly that of an aspiration to make dentistry the equivalent of an oral specialty of medicine in the quality and sufficiency of its service to the patient. It is realized widely among dentists that equivalence in health

service can be achieved, without embarrassing the present organization of the medical profession or disturbing the conduct of the medical schools, if dentistry, maintaining its professional independence and continuing its own schools, adapts its system of education and its practice to the attainment of this purpose. Accordingly, there has been increasing agreement among dentists that establishment of the following general conditions is essential for the most useful development of dental education:

1. The academic requirements for admission to the dental school should not be inferior, in extent or quality, to the minimum for the medical school.

2. The undergraduate dental curriculum, organized for the intensive training of general practitioners only, should include medical science, dental technology, clinical dentistry, and oral medicine, in courses better adapted for their purpose and much more effectively integrated than at present.

3. There should be effectual elimination of the redundancies in the undergraduate dental courses, which have been accumulating not only from the tendency to overload courses with minutiae that neither teachers nor students use or remember, but also from the impossible effort in the training of general practitioners to include the detailed information and the intricate procedures of such specialties of dental practice as maxillo-facial surgery and orthodontia.

4. Advanced courses for practitioners and full-year graduate curricula should be provided for all types of oral specialization.

5. Combined medical and dental curricula, for practitioners of the types of oral health-service that embrace most intimately the joint responsibilities of medicine and dentistry, should be developed in several of the universities having well-supported and closely coördinated medical and dental schools, hospitals, and dispensaries.

D

Dentistry, as a division of health service, should not be inferior to a specialty of the practice of medicine, either in intellectual quality or in usefulness. No other branch of health service is more advanced in the tactual, artistic, and mathematical refinements of its remedial efforts. It should receive, in accord with its contributions to human welfare, the serious attention that its character, capabilities, and enlarging responsibilities suggest. Nearly all of the dental schools are now integral parts of universities, and the independent school is about to become extinct. The dental school should be intimately correlated in the university with the medical school, hospital, and dispensary in a *health union* that would be serviceable to all of the factors concerned. The dental school requires

not only the equipment and facilities traditionally peculiar to it, but also good teaching and a useful library. It should promote research and conduct graduate work. It needs its share of the general income, and deserves recognition as an important unit in the life and work of the university.

Fortunately, the dental schools are being steadily improved. Nowhere are the evidences of growth and betterment more evident than in some of the schools in the universities represented in this Association. It is to be hoped that the leadership of these schools will speed the present evolution, and that their influence will quicken public interest in the adequate financial support of dental education. "There is today," to quote from Dr. Pritchett's Preface in the Carnegie Foundation's *Bulletin on Dental Education*, "no more direct method by which the public health can be served than to enable the universities to place their dental schools in a position to give the kind of education for which the world stands in need."

IV. THE REASONS WHY *FOUR* HAS BECOME THE ACCUSTOMED NUMBER OF YEARS IN THE EXTENSION OF ACADEMIC AND PROFESSIONAL CURRICULA[6]

ERNEST H. WILKINS, A.M., PH.D., LITT. D., *College of Arts, Literature, and Science, University of Chicago*

The reason why we have a four-year college in America today is that the first American institution of higher learning, Harvard, took form in the *seventeenth* century as a four-year college.

The reason why Harvard in the seventeenth century took form as a four-year college is presumably that the University of Cambridge in the *seventeenth* century required a four-year course for the Bachelor's degree.

The reason why the University of Cambridge in the *seventeenth* century required a four-year course for the Bachelor's degree is presumably that the University of Cambridge had *always* required a four-year course for the Bachelor's degree.

The reason why the University of Cambridge originally required a four-year course for the Bachelor's degree is presumably that the *University of Oxford* required a four-year course for the Bachelor's degree.

The reason why the University of Oxford originally required a four-year

[6] Quoted from a paper on "the relation of the senior college and the graduate school:" *Journal of the Proceedings and Addresses of the Association of American Universities*, Twenty-eighth Annual Conference, Northwestern University, Chicago, November 11–13, 1926; published in 1927, pp. 59–60. The italic does not appear in the original.

course for the Bachelor's degree is presumably that the students of the English Nation at the *University of Paris* followed such a course. A statute of that Nation, adopted in February, *1252*, specifies that the candidate for the Bachelor's degree "fidem faciet . . . . quod audierit in artibus per quinque annos vel quatuor ad minus."

The ultimate reason why we have a four-year college in America today is then presumably that the students of the English Nation at the University of Paris in the *thirteenth* century followed a course of four years as a minimum for the Bachelor's degree.

Naturally, the content of the four-year course has changed completely. The Parisian statute of *1252*, already referred to, prescribes the books to be read during the four-year course. They consist of several of the works of Aristotle, chiefly logical, and works by Boethius, Priscian, Donatus, and Gilbert Porretanus. *The Lawes of Harvard College agreed upon by the Overseers, President, and Fellowes* in *1655* set forth the curriculum as follows:

> "In the first yeare after admission for foure dayes of the week all Students shall be exercised in the Studies of the Greek and Hebrew tongues, onely beginning logick in the morneing towards the latter end of the yeare: unless the Tutor shall see cause by reason of theire ripeness in the languages to read logicke sooner. Also they shall spend the second yeare in Logick with the exercise of the former Languages and the third yeare in the principles of Ethicks, and the fourth in metaphisicks and mathematics, still carrying on their former studies of the week for Rethorick, oratory and Divinity."

Yet with all the changes wrought in the curriculum the four-year mold has been kept as sacrosanct.

It would seem to be unworthy of the spirit of modern America longer to be bound by an educational form devised to meet conditions which obtained in Europe in the thirteenth century.

It is of course perfectly true that an ancient form might by a combination of chances remain appropriate under changed conditions. If the four-year college is thus appropriate, well and good. If not, it should be recognized as vestigial, and should in general make way for a more modern type of educational organization.

In point of fact, the four-year college reveals no peculiar adaptation to our present needs. On the contrary, it is betraying more and more clearly the truth that it no longer constitutes a normal educational unit.

V. REPRINTS OF SOME REVIEWS OF THE CARNEGIE FOUNDATION'S BULLETIN ON DENTAL EDUCATION IN THE UNITED STATES AND CANADA[7]

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A. FROM THE *Journal of the American Dental Association*, 1927, XIV, PP. 2105–08. BY *Albert L. Midgley*, D.M.D., SC.D., F.A.C.D., SECRETARY OF THE DENTAL EDUCATIONAL COUNCIL OF AMERICA

The completion of a report to the Carnegie Foundation for the Advancement of Teaching, written by Dr. William J. Gies of Columbia University, entitled "Dental Education in the United States and Canada," marks the beginning of a new era in the progress of dentistry.

To review a work of such intensive research briefly, yet adequately, is an impossible task for the writer. And so this presentation takes the form of appreciation, with comments on the extent and quality of the report and on some of its significant pronouncements.

The report is a colossal contribution to the promotion of better health service, not only through dentistry but through medicine and other health-service agencies as well. It discusses dentistry not as a mechanical art but primarily as a *health service*, a viewpoint comparatively new. To the lay-

[7] Dental Education in the United States and Canada. A Report to the Carnegie Foundation for the Advancement of Teaching (1926). By William J. Gies, with a preface by Henry S. Pritchett, President of the Foundation. Bulletin Number Nineteen, Carnegie Foundation for the Advancement of Teaching (1927). Pp. xxii (preface) + 692. Copies may be obtained free of charge on application, in person or by letter, at the office of the Foundation, 522 Fifth Ave., New York City.

man and to many others, dentistry appears to be merely the art of dealing with the abnormalities and defects of the teeth; but this report of Dr. Gies shows conclusively that dentistry is more than that: it is inseparably allied with the practice of general medicine, with the fundamental medical sciences, and with the furnishing of health service to the community. Dentistry can no longer ignore its undeniable connection with the whole field of medicine. The author points out that the interrelation between medical and dental education and also medical and dental practice is becoming increasingly more intimate; which must in time result in closer relationship between the two professions.

This report is not a technical survey, intelligible and of interest to experts alone. It is, rather, a judicial, easily understood treatise on the present weaknesses and deficiencies and possible improvements in our system of education for the profession of dentistry. Its prevailing thought is better oral health service. Its purpose is to raise the standards and to enlarge the usefulness of such service in every practical manner. The spirit is one of openminded investigation, similar to the attitude of a report on medical education issued in 1910. It hopes to do for dental education what that earlier report did for medical education, drawing the attention of the scientific men of the country to a pressing need. Dr. Gies has no desire except to place dental education on a parity with the best medical education of today and that of the future; his report is in no sense propaganda for whatever individual ideas he may hold. The wisdom and the completeness of the report are bound to create a hitherto unknown interest in the current problems of dental education. He reminds us that medicine and dentistry are public possessions solely, and that the relations and activities of the two must be kept subordinate to the interests of community welfare.

This invaluable report required five years of constant application and intensive study, with unlimited sacrifice on the part of the author. Reflecting a wide range of understanding and a deep sincerity of purpose, it aims to elevate the standards of dentistry in all its aspects, cultural, technical and professional, and to place dentistry in its rightful position among the arts of healing. Presented interestingly and convincingly, after exhaustive study and analysis of theories, conditions and facts, it should command the serious attention and concern not only of teachers, practitioners and students of dentistry, but also of all interested in any form of health-service education.

The exceptional manner in which the study was conducted; the unusual display of skill and ability with which trying situations were met and vexing problems solved; the tact and diplomacy with which many of the opposing

individuals and agencies were brought to a closer understanding, and the logic and solidity of the conclusions which should raise dentistry from uninspiring surroundings of mediocrity to a plane of greater usefulness and excellence—all these qualities of the report are extraordinarily impressive.

The author has blazed a trail that must overcome unfortunate conflictions, and the work he has done is destined to lead to results of enduring value. In recognition of his attainments and service to the professions and the public, his name and activities will be linked forever in the annals of dentistry with those of Harris and Hayden.

The report, in scope, content and quality, is all that could be desired. The text covers all phases of the subject completely and accurately. The style is unusually effective; the conclusions are enlightening, and the proposed solution of the dental educational problem is unique and supported by convincing argument.

The ability of the author and the quality of the effort are clearly shown throughout the entire presentation, and his tireless energy and devotion to dentistry are plainly evident in the precise and unusual quality of detail work. It should be of immeasurable value to those interested in the promotion of dental education.

The statistical data, both the comparative and those on each school, are most informing. If one needed corroborative evidence to support the truth of statements or the accuracy of the opinions and conclusions, a thorough examination of the data in Part VI and the Appendix will convert the most incredulous.

Moreover, a review of the book would be far from complete unless mention were made of the author's mastery of the language. His ability to use clear, forceful English not only makes the report genuinely pleasant reading but also enables the reader to comprehend precisely the author's meaning. His choice of words is felicitous, and the whole presentation is unusually effective. What must appeal strongly to all, whether or not they are interested in the promotion of dental education, is the clarity of the report and the soundness and potential adaptability of his solution of the dental educational problem.

Dr. Gies has evolved a number of orderly conclusions, one of the most important of which is that dentistry cannot longer be ignored in the training of general practitioners of medicine and that reorganization of the dental educational program is needed to effect an equilibrium between the two sciences which does not now exist, and which, in justice to the public welfare, should be attained. The author believes education for physicians should include instruction in oral hygiene and clinical dentistry, while, at the same

time, the preparation for dental practice should provide training in oral medicine. Obviously, better health service through the improvement of the medico-dental relationship requires this coördination.

The readers will agree with the author that further advancement in dentistry is dependent on progress in dental education. As an effort to further this progress, the author proposes a reorganized system of education founded on the conclusions that he has formulated as a result of his investigations. These conclusions are based upon the conceptions (1) that dentistry is health service primarily, and (2) that dentistry should be fully equivalent to an oral specialty of the practice of conventional medicine in service value to the patient.

It is held by the author that dentistry, because of hitherto separate development, and unique mechanical and esthetic requirements, can attain its most desirable growth as an agency of health service by continuing as an independent profession, but it is urged that dentistry, in order to attain the widest usefulness, must be promoted by a reorganized system of education that will insure its professional equivalence to an oral specialty of medicine.

To achieve this end, Dr. Gies proposes the "two-three-graduate" plan,[8] which provides: (1) A liberal education of at least two years of academic study of such content that it will be a test of the genuine vocational adaptability of all students entering the predental course. This test will serve as a sound basis upon which to begin undergraduate studies. (2) At least three years of intensive and well integrated work in an approved dental school for training general practitioners only, the years to be lengthened wherever desirable; the student, at the end of his three professional years, graduating as a general practitioner knowing how to begin safely a dependable general practice and "possessing peculiar capacity to grow." The reduction in the number of undergraduate years in the dental school from four to three does not mean, however, less professional training, for, with a curriculum properly coördinated and unified, the student will be trained to view all his courses as bearing directly on his field of study rather than belonging to separate departments of knowledge. (3) An optional, supplementary, graduate year, for advanced training in all types of dental and oral specialization which should automatically promote research and improve methods of teaching in and insure better teachers of dentistry. (4) A combination of medical and dental curricula for the development of the more difficult aspects of oral medicine, which should assist effectively in the promotion of cordial coöperation between medicine and dentistry. The plan aims to have dentistry profit by some of the assets of medical teaching.

[8] A synopsis of this plan is presented on page 441 of this issue.

Ideal in theory and attainable in practice, the soundness and serviceability of the plan should commend it to all from the standpoint of altruism and progress.

The preface, written by Dr. Henry S. Pritchett, covers the entire field of the survey interestingly and conclusively. His health-service ideal offers a program that should yield the greatest measure of proficiency in practice and the widest degree of usefulness in public welfare; his eight propositions following definite and irrefutable premises may be aptly termed the beatitudes of future dentistry, as the perfection of dental health-service is encompassed by them. Dr. Pritchett states:

"The dental school is one of the most important of these agencies [for the training of a qualified body of public health servants]. . . . . The facilities for the education it seeks to offer cannot be furnished on a commercial basis. It must have generous financial help, such as has been accorded in the last ten years to many of our medical schools, if it is to carry out its duty to the public health service. There is today no more direct method by which the public health can be served than to enable the universities to place their dental schools in a position to give the kind of education for which the world stands in need."

His urgent plea for adequate financial support should appeal strongly to those in a position to give endowments. The dental profession is keenly sensitive to the vision of its future usefulness presented in the Carnegie *Bulletin*. Improvements there suggested will be rapidly forthcoming if the dental schools in the universities can be given the financial support that their needs warrant. With dentistry elevated to the educational standard of an oral specialty of medicine, yet a profession separate from it, proper mediums for more scientific advancement should be forthcoming in endowment form. When an equality between the two professional standards which Dr. Gies proposes can be achieved, those who can endow will.

If you would know American dentistry, the warp and weft of its historical, statutory, organizational, educational, and financial fabric, study the entire volume. If you have not the time for that, study the Preface and Chapter XII, "General views and conclusions," pages 225 to 240, particularly pages 239 and 240. If you cannot do that, reflect on this quotation, which is the quintessence of the book:

"To advance with cumulative success as a mode of health service, dentistry, represented by the great body of independent general practitioners, must be intellectually vigorous, mechanically facile, esthetically felicitous, medically competent, ethically sincere, professionally keen, and socially altruistic."

In passing, one should pause to give gratitude to the Carnegie Foundation for making possible to the dentists of the United States and Canada this

stimulating, helpful *Bulletin*. It is invaluable to the entire dental profession of the world. Let us hope it foreshadows the "dawn of the days to be."

To Dr. Gies is due the sincerest thanks of all dentists; not solely for the finiteness of the book, but also for the ennobling attitude that undertook it. Most fortunate is the Carnegie Foundation in having secured his services.

[In a footnote it is stated that this review is preliminary to a more extended one to be published by Dr. Midgley.—*Ed.*]

B. FROM THE *Journal of the American Medical Association*, 1927, LXXXIX, PP. 623–24. *Editorial*

Dentistry, no longer a subsidiary and handmaiden to barbering and blacksmithing, presents itself today as an independent scientific profession. Its trials and vicissitudes, from the care of the dental furniture of ancient Egyptians and Hindus to its present high state, are traced magnificently in the report on Dental Education in the United States and Canada just issued by the Carnegie Foundation for the Advancement of Teaching. The first books on dentistry were published in the United States in 1801 and 1802, and the first dental school was established in 1840. The American Society of Dental Surgeons was likewise established in 1840 as the first national association of dentists. In 1913, the national dental association was reorganized on a plan similar to that followed by the American Medical Association. Today dental schools, dental journals, research institutions and other organizations represent the tremendous progress that has been achieved.

From the first, physicians and dentists have been unable to agree with one another or among themselves as to the position of dentistry in relation to medicine. The present report of the Carnegie Foundation is an attempt to outline a plan for progress in the future which will take into account the needs of both professions. In his preface to the report, President Henry S. Pritchett emphasizes that the practice of dentistry cannot now be made a specialty of the conventional practice of medicine, but should remain a *health service* equal in importance to the other specialities of medicine. He feels that dentistry should require for entrance to the profession such preliminary education as will prepare the candidate for professional study, and that it should contain in its own curriculum sufficient of the medical sciences, dental technology, clinical dentistry and oral medicine to afford a sound basis for the general practice of dentistry. The report calls for at least two preprofessional years of college study, three years for the undergraduate curriculum instead of four, and an optional full year of graduate study for

systematic training in oral specialization. There seems to be need also for combined dental and medical courses for the training of specialists in oral surgery, public health service, dental research and other subjects in the field common to the two. With dentistry, as with medicine, it is felt that the provision of adequate service for the middle class is the big problem of the future. The Carnegie Foundation is supporting one effort in this direction, but the president feels that the first step must be the training of a qualified body of men.

The report of the Carnegie Foundation brings to light a series of problems for research in dental schools, including studies of normal dentition, of destructive factors in the mouth, of abnormalities, and of the chemistry, physics and biology of the teeth. Complete details are presented as to existing conditions in the United States and Canada with a report on the status of dentistry in each of the states, an assembling of a vast amount of data of inestimable value to any one who wants to speak soundly on the subject.

Few medical schools give much attention to the care of the teeth and mouth, although formal courses on the eye, ear, nose and throat are regularly included. Orientation courses on the chief correlations between medicine and dentistry, such as are now offered by the medical schools of Minnesota and Toronto, are recommended as being of special value to physicians, and medical schools throughout the country are urged to look into the possibility of providing such special courses.

As was the case with medical schools, dental schools are now tending more and more to become integral parts of universities, and as such to fit in with the general scheme of education. The importance of dentistry in relation to bodily health is now widely recognized. The search for the causes of dental decay and of diseases of the teeth and mouth must become a search from the medical angle as well as from the point of view of mechanics. In the past, dentistry has been too deeply absorbed in oral mechanics. The elaboration of dental practice into a health service that would be, in fact, a department of the healing art will involve readjustments that should be made with a minimum of disturbance of the status quo. The plan suggested in the report issued by the Carnegie Foundation is worthy the careful consideration of all who have at heart the interest not only of medicine and dentistry but primarily of the public health.

C. FROM THE *Dental Outlook*, 1927, XIV, PP. 245–47. *Editorial* ("*M.W.*")

The annals of medicine are replete with great names. Brilliant scientists achieved fame that will endure so long as humanity whom they served en-

dures. Dentistry, being comparatively a young profession, cannot boast of great names that fire the imagination. The service with which the dental profession has been preoccupied failed to impress men of science that dentistry is a vital element in the health of the nation.

Professor William J. Gies became interested in dentistry not because of what it has done but because of what it might do. Convinced that public interest demanded the best of which dentistry is capable, he conceived it his duty, as a scientist and as a citizen, to arouse the dental profession to a fuller realization of its greater obligations to the public.

Bringing to his task the ripe experience of the trained educator, Professor Gies soon discovered that the dental profession's limited horizon must bear some relation to the existing standards of dental education. Thereafter, dental education became his first concern. Obtaining a leave of absence from Columbia University and under the auspices of the Carnegie Foundation, Professor Gies embarked upon an intensive study of dental education in the United States and Canada. He gave six years of his life to this task. His findings are published in a voluminous report bearing a message to every serious-minded student in the dental profession.

How will the dental profession receive this message? Will it justify the hopes of Professor Gies and reach out for the high estate to which dentistry as a *health service* can raise it? Professor Gies holds the mirror, bidding dentistry gaze into the future. Dentistry sees itself full grown, no longer limited to a mechanical art but devoted to the prevention of disease through health service.

Health service! We bless you Professor Gies for teaching us these words. No two words in our language carry more inspiration. Where is the service with a larger patriotic appeal? Man-power can only be maintained through health service. Wars are won not by armaments but by man-power. Economic development is attained not through capital but through man-power. Our four hundred billions of national wealth and sixty billions of annual national income we owe to man-power. A profession devoted to the preservation of that man-power through health service renders the highest form of patriotic service.

The dental profession has been called upon to meet the problem of preventable disease that is waging ceaseless war against man, bent upon his extermination. The annual cost to the nation through illness mounts into the billions in treasure and hundreds of thousands in lives. No war in which our country ever engaged has sapped our national vitality to the degree so insidiously attained by preventable systemic disease. The nation calls upon the medical and dental professions to respond to their patriotic duty and free our fellow citizens from the menace of preventable disease.

Professor Gies stresses this mandate to the dental profession. To him belongs the glory of having provided dentistry with both a foundation and a horizon.

For his labors in behalf of a broader field of usefulness for the dental profession with the added prestige that must flow from it, the dentists of America are truly grateful to Professor Gies. How to indicate their gratitude in a concrete and appropriate form presents no simple problem. Professor Gies desires no personal gifts for his contributions to dental progress. But he does desire to see dentistry attain the dignity of a learned profession through scientific research. Do the dentists of America share Professor Gies' ambition for the progress of their profession? Their support of the William J. Gies Fellowship in Biochemistry at the Columbia Medical and Dental Schools[9] will be the measure not only of their interest in scientific research but also of their appreciation of Professor Gies' labors in behalf of dentistry.

The Fellowship has received the official endorsement and support of every dental society in Greater New York. Professor Gies' labors are not for a single group but in the interest of the entire dental profession. The profession should emulate his example and unite in whole-hearted support of the Fellowship and thus not only do honor to Professor Gies but bring honor to their profession by giving concrete evidence of their serious interest in scientific research.—*M. W.*

D. FROM THE *Pacific Dental Gazette*, 1927, XXXV, PP. 501–05. *Editorial*

Professor William J. Gies of Columbia University has just completed the gigantic task for which he assumed the responsibility, in behalf of the Carnegie Foundation for the Advancement of Teaching, four years ago or thereabouts.

To those who have followed Prof. Gies' activities along other lines, to them indeed it was a foregone conclusion that exhaustiveness and adherence to accuracy in details would be the characteristic features of the study on dental education undertaken by him and carried out with the open coöperation of the Educational Council, the dental schools and dental societies of the country.

It has been an arduous task which has consumed several years to complete and one which could hardly have been brought to an end in less time without sacrificing somewhere its exceptional value as an exhaustive historical record of dentistry from its inception as a profession to the present day.

[9] See page 530.

As the result of this analytical educational survey certain facts have been brought out in the actual field of education and in the scope of the preparatory training upon which such professional education should be superimposed. In its cultural aspect, dentistry has been somewhat slow in accepting such requirements as have been imposed by other professional groups upon those seeking admission into their ranks and to this phase of dental education has been given some serious thought by Prof. Gies and in his recommendations along the line of educational reconstruction certain changes are urged which, if adopted, will automatically dispose of any criticism directed at the insufficiency of cultural preparation.

The plan of dental education which is in operation at the present time in most of the schools of the United States does not receive the approval of Prof. Gies, and in this connection criticism is also directed at the quality of teaching in medical schools. The aim of this survey is decidedly constructive and the suggestions to change the methods of acceptance of students and the teaching of the art and science of dentistry are deserving of careful thought and sympathetic consideration even though they may appear, at first glance, as detrimental to the technical development of dental students.

The so-called two-three [graduate] plan is the outstanding conclusion of the survey as directly affecting dental educational methods and pre-professional education.

The prospective dental student is to be so prepared academically and culturally as to be the equal in this respect of students in any other profession and to be in a position, mentally, to accept such training as is presented to him in the various required sciences and in the strictly professional subjects, at its true value; also with a fair understanding of its application to the final purpose in view as expressed in terms of prevention and curability, all of which is encompassed in the term "*health service*" as freely referred to by Prof. Gies throughout the many pages of his history-making volume. The actual teaching of the dental subjects is to be carried out in three years after the curriculum which is now in operation generally has been purged of superfluities and the teaching of special subjects detached from the main body of the dental program and intrusted to the same dental schools, but in separate departments of post-graduate and graduate instruction.

Some of the most important conclusions of this educational survey are as follows:

(1) "Dentistry is not only a mechanical art for the maintenance or restoration of dental functions and facial comeliness, but as one of the most useful means to keep people well and to cure or alleviate disease, it is also an important division of health service.

(2) "Dentistry, in the quality and efficiency of its health service for the patient, should be made the full equivalent of an oral specialty of the practice of medicine, without impairment of its present mechanical and artistic efficiency in reparative treatment.

(3) "This could be accomplished, without requiring the dental student to obtain a full medical education, through extension and improvement in universities of that system of dental education which, though separate from medical education, is closely related to it and should be more intimately associated with medical schools, hospitals and dispensaries.

(4) "Improvement of dental education, in accord with the suggested reconstruction of medical education, could best be brought about by pursuit of the following three main objectives: (a) the preliminary education and the instruction in the fundamental sciences should be practically the same in general scope and quality as for medicine after the proposed improvement of the medical curriculum; (b) the training peculiar to dentistry should be sufficient to assure both ability to initiate safely a dependable modern general practice of dentistry and capacity to grow in proficiency; and (c) the most advanced phases of dental practice should be reserved for systematic optional graduate study by prospective specialists.

(5) "These three main objectives could be attained through the requirement of (a) two years of preparatory work in an academic college, including several extra courses, such as mechanics and fine art, that would stimulate interest and develop ability in the prospective practice of dentistry or reveal ineptitude, (b) and three years of intensive and well-integrated effort in an undergraduate dental curriculum for the training of general practitioners only (the years to be lengthened by beginning them with summer sessions or otherwise, wherever favorite excesses cannot be discontinued); followed by (c) optional supplementary full-year graduate curricula for all types of specialists. On this program, currently known as the 'two-three-graduate plan,' general practitioners could be trained in five years after graduation from high school."

While it is quite likely that the plan suggested by Prof. Gies does not satisfy the technical ideals of teachers, generally, and that there are those who believe that three years is not a sufficiently long teaching period to cover all the details of dental practice, the program suggested, it should be remembered, "aims to prepare the student to initiate safely a dependable general practice, to continue to be an earnest student throughout his career, and to grow rapidly in capacity through experience."

The study of dental conditions, now ready for distribution without charge, is an *opus magnus*, it is the pioneer study in this field, and is the fruit of untiring efforts over a period of many years; it displays a commendable disposition to encourage progressive tendencies in dental education; it is an exhaustive analysis of every phase of dental activity, with such commentaries as will aid the reader in acquiring a view of dental education thorough, fair and accurate. It is a monumental work permeated throughout with a desire to be fair to all concerned, and because it is a critical study of existing conditions, some of the things that are said will not be accepted everywhere without the feeling that the investigator has been in certain instances rather severe and unshakable in his convictions.

E. FROM THE *Medical Journal and Record*, 1927, CXXVI, P. 393.
Book review

This work would seem from its title to be one essentially for those interested in dental education. But this is not the case. While it is not a book which can be read from cover to cover, its use is intended for reference for those interested in health service.

This *Bulletin* contains 692 pages dealing with dental education in every phase. For example, history of dentistry, history of dental education, predental, dental and postgraduate education, dental society work and its influence on dental education, the social and cultural phases of dentistry, research work, the financial side of dental education, viz., cost of educating students, salaries to teachers, with a complete survey showing lack of endowment and donations to the cause of dental education—and the legal aspect which includes the predental and dental requirements of every state and province in the United States and Canada.

Every one interested in health service should read the preface by Henry S. Pritchett with its eight condensed conclusions.

The author throughout his work emphasizes the fact that dentistry is a branch of *health service*, which cannot be made a specialty of the conventional practice of medicine because of its highly technical (manual dexterity) nature. He also points out the fact that its mechanical and medical aspects cannot be separated because of the fact that its mechanical operations must of necessity be performed within the oral cavity. His recommendation for the combining of predental and dental education in such a manner as to save time, raise the cultural standing and to make better dentists, is superb.

Part five, entitled "General views and conclusions," should be read by every dentist, particularly Section D, "Main requirements for the improvement of oral health-service," which contains the author's recommendations for raising the standard of dentistry, not only its technical but its professional and cultural standard. Subdivision F, on page 239, entitled "General conclusions," is of particular interest and should be made into a small bulletin to be read by everybody engaged in health service.

This *Bulletin* should be in the hands of all educators so that the youth contemplating the study of dentistry can be guided to or discouraged from its further study. If there has been a phase of the subject untouched by the author I have not been able to find it.

The Carnegie Foundation deserves great credit for undertaking and carrying through this great survey for which there is no precedent save that of a similar survey of medical education published in nineteen hundred and ten.

They are to be particularly commended for their choice of Professor William J. Gies as their investigator and author. His ability as an educator with his particular application to health service, his temperament and industry, make him the one best fitted to have carried through to so magnificent a conclusion this much needed work.

F. FROM THE *Atlantic Medical Journal*, 1927, XXX, PP. 712–13. *Editorial*

In this number of the [*Atlantic Medical*] *Journal* appears a summary of *Bulletin Nineteen* of the Carnegie Foundation, which is the report of a study made of dental education in the United States and Canada.

The report truly states that physicians seldom give attention to dental conditions. This no doubt is due to the fact that little or no instruction is given in the medical schools on dental disorders, which explains why medical students acquire the prevailing medical indifference to dentistry.

The report also cites the general state of disinterest on the part of the physician in periodic health examinations in comparison with the systematic encouragement given by the dentists to their patients to have periodic examinations for the detection and treatment of dental disorders in their incipiency.

That "prevention of dental deficiencies in children is the most urgent general responsibility of the dental profession" is very true, and we as physicians must realize our responsibility, by referring all children showing any need for dental attention to the dentist. We have been too negligent in the past in this regard, and should no longer permit such indifference.

While the medical-school curriculum is overloaded in many respects, still it would be a distinct advantage to have a few lectures given during the junior year by a dentist, so that the medical student may be properly informed in regard to the relation of the physician to dentistry.

Our members should read this summary not only to be better informed upon matters pertaining to medicine and dentistry, but for much valuable information it contains for the physician.

We must realize the importance of our daily association with dentistry, and the summary of the *Bulletin* will afford much enlightenment.

G. FROM THE *Michigan State Dental Society Bulletin*, 1927, IX, PP. 13–14. *Leading article, unsigned*

Nothing so significant to the progress of dentistry has happened in years comparable to the report recently made public on "Dental Education in the United States and Canada," prepared by William J. Gies. This is an

unqualified statement, but we have no hesitation whatever in making it. The report was made under the direction of the Carnegie Foundation for the Advancement of Teaching and bids fair to do for dentistry what one made some years ago under the same auspices on medical education has already done for medicine.

It was in 1921 that Dr. Gies, a teacher of note in Columbia University, was asked to assume the direction of such a survey. That this was a wise choice is made evident throughout the entire volume of 692 pages. Systematic arrangement, keen analysis, a penetrating breadth and grasp of the subject that is astonishing, simply make a dentist marvel as he peruses these interesting pages.

There is an introduction by Henry S. Pritchett, President of the Foundation, a brief but illuminating history of dentistry, discussion of dentistry and health, dentistry and medicine, and the status of dentistry in each state. This includes population, number of dentists and physicians, legal requirements for the practice of dentistry, number of medical schools and number of dental schools. Under dental schools, every useful detail of history, teaching, finances and equipment are listed in the same way for all, followed by a summary and general comment.

Michigan dentists as well as the people of Michigan have great cause for just pride in the showing of our own dental college in this impartial report. The College of Dentistry at Ann Arbor ranks right up at the top and the BULLETIN wishes to extend hearty congratulations to Dean Ward and his able corps of teachers. The founders builded well and their successors have been able to maintain and add to that lofty tradition in a rapidly developing period that called for vision and constructive leadership.

There are very many paragraphs that we would like to copy and pass on to our readers who do not see them and as occasion permits we will give you some of these choice portions.

We are sure that the first item we should publish from the report is the "Summary and general comment on the Dental College of the University of Michigan." It seems that the same thought was also in the mind of the President of the First District, Dr. Pat O'Reilly, for he sends us a suggestion to publish this Summary together with a letter concerning it from Dean Ward. . . . . It is also worthy of note that Dr. O'Reilly is not an alumnus of the University of Michigan, but his satisfaction in her standing seems just as great as those of us who are.

There is a temptation to say much more about this whole report by Dr. Gies, for it commands much respect and admiration for a task done with such consummate skill. That it will stand always as an authority on the status

of dentistry today in the United States and Canada and the right pathway for its future progress seems certain. But there is one in our midst who has watched the development of this investigation from the beginning, and no one whom we could secure is so competent to discuss its origin, progress and significance as our own Dean. Dr. Ward has promised the editor a comprehensive article on the Carnegie Report for an early issue, probably September.

H. FROM THE *Minneapolis District Dental Journal*, 1927, X, PP. 15–16. *Editorial*

The *Bulletin on Dental Education* by the Carnegie Foundation is entirely too comprehensive to sum up item for item, editorially. We would therefore suggest that each dentist read it for himself. It is enlightening, instructive, interesting and thorough. It leaves a most optimistic reaction.

To us, the outstanding statement would be: "The public suffers when any group engaged in *health service* belittles the honorable efforts of another." This statement reaffirms the expression of our national president that "co-operation is needed." Therefore with closer affiliation, and better standardization of training, we may look forward to a future for dentistry with a still greater part to perform in the promotion and care of human health.

I. FROM *Oral Health*, 1927, XVII, PP. 434–35. *Editorial*

The Carnegie Report on Dental Education by Professor William J. Gies covers an exhaustive study extending over a period of five years. It is very comprehensive in its dealing with various phases of dental science and practice, and particularly so in the relations of dentistry to medicine. The report has just come from the press and is a 700-page volume containing much valuable information of an historical nature as well as detailed data regarding all of the dental schools on this continent. Being well arranged and adequately indexed, it will prove of permanent advantage as a work of reference. Dr. Gies' study has certainly given an impetus to dental education in all of the universities of Canada and the United States.

The several faculties of Dentistry of the Canadian universities are quite in accord with the general principles contained in the report, and particularly the requirement of two pre-dental years. In some Canadian universities, and in many colleges in the United States, these two years are given in the Faculty of Arts, while in others a candidate is permitted to take the first pre-dental year in high school (honour or senior matriculation), and the second in the Faculty of Dentistry, being the first year of the five-year dental course which leads to the degree of Doctor of Dental Surgery.

All of the Canadian schools and, with few exceptions, those in the United States, require for graduation four years beyond the pre-dental requirements, whereas the Carnegie Report suggests two years of pre-dental studies followed by three [conventional or lengthened] years in the Faculty of Dentistry, and, in addition, an optional fourth year for graduate study. There appears to be a general feeling throughout Canada, and in many universities in United States, including New York State, that the graduate year suggested by Dr. Gies should be compulsory as an integral part of the regular undergraduate course, making the course two-four or six years beyond Arts Matriculation.[10]

The dental profession is under a great debt to Dr. Gies for the personal sacrifices he has made in devoting his entire time for the past five years to this study. It is expected that Dr. Gies will now resume his work as Professor of Biochemistry in Columbia University, and he may do this in the full assurance that he has well earned and will receive the sincere thanks of the dental profession for the outstanding contribution he has made to Dentistry.

VI. WILLIAM J. GIES FELLOWSHIP IN BIOLOGICAL CHEMISTRY[11]

FREDERICK G. GOODRIDGE, *Chairman*, and Paul E. Howe, *Secretary, General Committee;* WILLIAM B. DUNNING, *Chairman*, and LEUMAN M. WAUGH, *Secretary, Dental Committee*

The Joint Committee in charge of the Fund for the creation of the William J. Gies Fellowship in Biological Chemistry has announced that the income from the Fund—approximately $1000 for the academic year 1927–28—is now available, and that a Fellow is to be appointed. This Fund has been established in recognition, and in honor, of the eminent service of Professor Gies to science, public health, and education since the founding of the Department of Biological Chemistry at Columbia in 1898. The capital funds that support the Fellowship are now in the possession of the Trustees of Columbia University for administration. The income will be used for the promotion of biochemical research and teaching in medicine, dentistry, nursing, and other phases of health service. Further increase in the capital

[10] This opinion was published before the New York State Department of Education reduced its minimum total number of required "clock hours" for the D.D.S. curriculum to 3600, and gave registered schools freedom to conduct it in three lengthened years. See pages 455–56 of this issue.—[*Ed.*]

[11] Received for publication on December 9, 1927.

amount is planned, and the Fund remains open for additional contributions. Annual reports will be published in this JOURNAL and elsewhere.

The funds for the maintenance of the Fellowship will be administered by Columbia University on substantially these terms of agreement:

The Fund shall be designated the William J. Gies Fellowship Fund in Biological Chemistry.

Fifty per cent of the net income per year may be expended for the promotion of research in general biology, dentistry, or medicine, during the first decade after the date hereof; 70 per cent may be so expended during the second decade; 90 per cent during the third decade; and thereafter the entire net income may be so expended.

All unexpended income shall be added to the principal, but such additions to the principal, after the first ten years, may be used in whole or in part as a loan fund, and may continue to be so loaned as returned from time to time by the borrowers.

The Fellowship and loans shall be awarded to students having prerequisites for admission to graduate study in biological chemistry, and on the basis of superior merit only, irrespective of institutions.

Selections of the Fellows, and loan grants to students, shall be made by the University Council on nomination by the Executive Officer of the Department of Biological Chemistry, except that during the lifetime of Dr. William J. Gies, while he remains in an active relation to biochemistry in his present position or any other than that of Professor of Biological Chemistry at Columbia University, suggestions from Dr. Gies shall be received, by the then executive officer of the Department, as being equivalent to nominations.

If at any time the Department of Biological Chemistry should be merged with or absorbed by any other Department of the University, the Trustees of the University shall determine in what manner and by whom the Fellows shall be selected and the loans to students allotted.

VII. "AMERICAN DENTAL DEGREES IN THE UNITED KINGDOM"[12]

It transpires that the General Medical Council of Great Britain has held that those dentists who possess the D.D.S. degree in addition to their L.D.S. diploma are not allowed to use their title in Great Britain, as it is held that [the] D.D.S. degree is not a registrable qualification in Great Britain.

[12] Reprinted from the *Indian Dental Journal* (Calcutta), 1927, ii, p. 87. (Anonymous.)

This decision of the General Medical Council seems almost grotesque when we see that graduates of the Japanese Dental Colleges are entitled to registration in Great Britain. The whole world knows that the United States possess the best equipped, managed and staffed dental schools in the world. The dental schools of the American Universities attract students from all parts of the world including England. No greater tribute can be paid to the efficiency of any class of teaching institution. English dental educationists, who have visited the United States, are unanimously of the opinion that the Class A dental schools of the United States are by far the best in the world. The writer has visited the prominent dental schools in England as well as in the United States, and can unhesitatingly say that it will take years and years to duplicate in Great Britain any dental school of the standard of the dental schools of the Universities of Pennsylvania, Harvard, Northwestern, Michigan, Minnesota, Iowa, and California. There may be honest differences of opinion with regard to the curriculum and course of studies. But we fail to see how the graduate of the Nippon Dental College is eligible for registration in Great Britain, while the graduate of the Evans Institute is not.

To us in India, the conflict does not apply in any way. But as outside observers we feel that the Dental Board, as well as the General Medical Council of Great Britain, has been biased in this respect out of fear of the fact that those possessing American degrees will attract more patients than those that do not. This attitude is unfair to the British public for whose benefit the General Medical Council is constituted. And our reading of the British Dental Act of 1921 leads us to believe that the interpretation given to the law has not been what was meant by the framers of that Act.

VIII. "YELLOW DENTAL JOURNALS"[13]

Ever since dentistry became a profession its chief medium of information has been provided by the commercial dental journals. A few of these represent years of unselfish effort on the part of some dental supply houses to honestly help the dental profession to maintain its dignity and self respect. All honor to these houses and to the editors of their journals. But in the last few years the mails have been flooded with a sort of yellow dental journal of which about one-tenth of the contents is matter pertaining to dentistry. The other nine-tenths is nothing but cheap, gaudy advertisements of their several wares. In fact just enough so-called educational material is included to obtain second-class mailing privileges. Seldom are the articles

[13] Reprinted from the *Apollonian* (Boston), 1927, ii, pp. 245–46. *Editorial.*

worth reading at all, but sad to relate ever so often a so-called reputable dentist practising behind a one-foot sign and connected with reputable dental schools and societies contributes to these dental monstrosities. Why, I do not know; because it is quite apparent that it is the cheapest form of advertising. At times it would almost seem that they are reimbursed for the use of their names. These men do a lot to encourage this type of yellow dental journalism and should be as severely censured by their state societies as are dentists who are guilty of less unethical conduct.

I am sure that the real commercial dental journals regret the advent of these yellow pamphlets, and the sooner dentists refuse to trade with this type of dental supply house, the sooner will a stop be put to this newest outrage of our professional standards.

IX. IMPORTANT BOOKS RECENTLY RECEIVED BY THE JOURNAL OF DENTAL RESEARCH

The life and work of James Leon Williams. By GEORGE WOOD CLAPP, D.D.S., 220 West 42nd Street, New York City. With an introduction by C. N. Johnson, M.A., D.D.S., F.A.C.D., President of the American Dental Association. 1925: pp. 299; 7¼ x 3¾ in.; 114 illustrations; $2.00. Dentists' Supply Company, New York City.

This book is a pleasing presentation of a man who, endowed with unusual faculties, used them to the best advantage; a man who was a success in private practice and is noted as a scientist, investigator, author, painter, anthropologist and philosopher; a man to whom the dental profession is deeply indebted.

Dr. Williams' interest in scientific investigation manifested itself at an early age, and in spite of environmental handicaps he set out to study microscopy. In 1882 the *Dental Cosmos* published his first article on the histology of the teeth and contiguous parts. He soon became known as an authority on the structure of the enamel, a position that he still holds. His second great contribution to dentistry was his work on tooth form for porcelain teeth. He overthrew the old temperamental theory, and inaugurated the system that revolutionized the art of denture prosthesis. His classification of the human teeth into three typal forms has been universally accepted. This line of investigation led him into the study of anthropology, and he collected models of all the prehistoric skulls then in existence. This collection is now in the possession of the American Museum of Natural History, New York, and formed the nucleus of their exhibit on prehistoric man.

To few of us is it permitted to become famous in a single line of endeavor, but when a man, such as Dr. Williams, has become noted in several distinct fields, then the story of his life and achievements is one of intense interest.—*Allan M. Johnson.*

The dentist's own book. By C. EDMUND KELLS, D.D.S., F.A.C.D., 1237 Maison Blanche, New Orleans. 1925: pp. 510; 7⅛ x 4⅝ in.; 116 illustrations; $7.50. C. V. Mosby Company, St. Louis, Mo.

Pathology of the mouth. By FREDERICK B. MOOREHEAD, M.S., D.D.S., M.D., Dean, and Professor and Head of the Department of Oral Surgery and Pathology, and KAETHE W. DEWEY, M.D., Assistant Professor of Pathology, College of Dentistry, University of Illinois, Chicago. 1925: pp. 540; 6¾ x 4⅛ in.; 213 illustrations; $7.00 net. W. B. Saunders Co., Philadelphia and London.

The technic of local anesthesia. By ARTHUR E. HERTZLER, A.M., M.D., Ph.D., LL.D., F.A.C.S., Professor of Surgery, School of Medicine, University of Kansas, Kansas City, Kansas. *Third Edition.* 1925: pp. 272; 7½ x 4½ in.; 140 figures; $5.50. C. V. Mosby Company, St. Louis, Mo.

Principles of exodontia as applied to the impacted mandibular third molar. A complete treatise on the operative technic, with clinical diagnoses and radiographic interpretations. By GEORGE B. WINTER, D.D.S., F.A.C.D., Professor of Exodontia, School of Dentistry, Washington University, St. Louis, Mo. 1926: pp. 835; 7½ x 4½ in.; 834 figures; $15.00. American Medical Book Company, St. Louis, Mo.

Applied biochemistry. By WITHROW MORSE, Ph.D., Professor of Physiological Chemistry and Toxicology, and Joseph M. Looney, M.D., Assistant Professor of Physiological Chemistry, Jefferson Medical College, Philadelphia, Pa. *Second edition.* 1927: pp. 988; 7⅝ x 4¼ in.; nearly 300 illustrations; $7.00. W. B. Saunders Company, Philadelphia and London.

Local anesthesia simplified. By JOHN JACOB POSNER, D.D.S., Chief of the Dental Department, Harlem Dispensary, New York City. 1924: pp. 114; 7 x 4⅛ in.; 55 illustrations; $3.50. C. V. Mosby Co., St. Louis.

Personal hygiene for nurses. By JOHN WYMOND MILLER BUNKER, Ph.D., Associate Professor of Biochemistry and Physiology, and CLAIR ELSMERE TURNER, M.A., C.P.H., Associate Professor of Biology and Public Health, Massachusetts Institute of Technology. 1924: pp. 189; 6 x 3½ in.; 6 illustrations; $2.00. C. V. Mosby Co., St. Louis.

Essentials of physiology, including the pharmacodynamics of the important typical drugs. By GEORGE BACHMANN, M.S., M.D., Professor of Physiology, School of Medicine, Emory University, and A. RICHARD BLISS, Jr., A.M., Phm.D., M.D., Professor of Pharmacology and Director of the Departments of Pharmacology and Physiology, Colleges of Medicine and Dentistry and School of Pharmacy, University of Tennessee (Memphis). 1924: pp. 343; 8¼ x 5 in.; 178 illustrations; $4.00 net. P. Blakiston's Son and Co., Philadelphia, Pa.

Physiological and clinical chemistry. By WILLIAM A. PEARSON, Ph.C., Ph.D., M.D., Professor and Head of the Department of Chemistry, Physiological Chemistry, and Toxicology, and JOSEPH S. HEPBURN, A.M., B.S.

in Chem., M.S., Ph.D., Associate Professor of Chemistry, Hahnemann Medical College and Hospital, Philadelphia. 1925: pp. 305; 6¼ x 3¾ in.; 30 illustrations; $4.00. Lea and Febiger, Philadelphia.

Textbook of physiology. By WILLIAM D. ZOETHOUT, Ph.D., Professor of Physiology, Chicago College of Dental Surgery, Loyola University. *Second edition.* 1925: pp. 616; 6¾ x 4 in.; 186 illustrations; $4.50. C. V. Mosby Co., St. Louis.

Physiological chemistry; textbook and manual for students. By ALBERT P. MATHEWS, Ph.D., Professor of Biochemistry, University of Cincinnati. *Fourth edition.* 1925: pp. 1233; 7¼ x 4½ in; 109 illustrations; $6.50. William Wood and Co., New York City.

Bacterial infection, with special reference to dental practice. By J. L. T. APPLETON, Jr., B.S., D.D.S., Professor of Microbiology and Bacteriopathology, Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania. 1925: pp. 474; 7¼ x 4 in.; 96 illustrations; $6.00. Lea and Febiger, Philadelphia.

Physical chemistry in biology and medicine. By J. F. MCCLENDON, Ph.D., Professor of Physiologic Chemistry, and GRACE MEDES, Ph.D., Assistant Professor of Physiologic Chemistry, Medical School, University of Minnesota (Minneapolis). 1925: pp. 425; 6¾ x 4 in.; 34 illustrations; $4.50. W. B. Saunders Co., Philadelphia and London.

Dental materia medica and therapeutics, with special reference to the rational application of remedial measures to dental diseases. By HERMANN PRINZ A.M., D.D.S., M.D., Sc.D., Professor of Materia Medica and Therapeutics, Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania. *Sixth edition.* 1926: pp. 632; 7 x 4¼ in.; 146 illustrations; $6.00. C. V. Mosby Co., St. Louis.

Technic of oral radiography. By CLARENCE O. SIMPSON, M.D., D.D.S., F.A.C.D. 1926: pp. 207; 3¾ x 4 in.; 165 illustrations; $5.00. C. V. Mosby Co., St. Louis.

Orthodontics: an historical review of its origin and evolution. (Two volumes.) By BERNHARD WOLF WEINBERGER, D.D.S., Librarian, First District Dental Society of the State of New York; Advisory Librarian, Dental Department, New York Academy of Medicine, New York City. 1926: pp. 1011; 7¾ x 4⅝ in.; 599 illustrations; $25.00 (two volumes). C. V. Mosby Co., St. Louis.

A textbook of exodontia—exodontia, oral surgery, and anesthesia. LEO WINTER, D.D.S., Professor of Oral Surgery, College of Dentistry, New York University. 1927: pp. 364; 7⅓ x 4⅓ in.; 329 illustrations; $7.50. C. V. Mosby Co., St. Louis.

Harelip and cleft palate (cheiloschisis, uranoschisis, and staphyloschisis). By MATTHEW N. FEDERSPIEL, B.Sc., D.D.S., M.D., F.A.C.S., Professor of Oral Surgery, Marquette University. 1927: pp. 200; 6¾ x 4 in.; 156 illustrations; $5.00. C. V. Mosby Co., St. Louis.

A text-book of bacteriology for dental students. By ARTHUR BULLEID, L.R.C.P. (London), M.R.C.S., L.D.S. (England), Assistant Dental Surgeon and Assistant Bacteriologist, Guy's Hospital, London. 1927: pp. 219; 6½ x 4 in.; 60 illustrations; $4.50. C. V. Mosby Co., St. Louis.

Textbook of biological chemistry. By JAMES B. SUMNER, Ph.D., Assistant Professor of Biological Chemistry, Cornell University (Ithaca). 1927: pp. 283; 6¾ x 4 in.; 6 illustrations; $3.50. MacMillan Co., New York City.

American text-book of operative dentistry. By MARCUS L. WARD, D.D.S., D.D.Sc., F.A.C.D., Editor; Professor of Dental Metallurgy and Crown and Bridge Work, and Dean, College of Dental Surgery, University of Michigan. *Sixth edition.* 1926: pp. 818; 7⅜ x 4¼ in.; 783 illustrations; $10.00. Lea and Febiger, Philadelphia and New York.

Annuario dental 1926. By Salvador de Casas (and numerous collaborators). *Fifth edition.* 1926: pp. 462; 6¾ x 4⅛ in.; nearly 200 illustrations; 12 Pesetas. Salvador de Casas, Calle de Galileo, No. 5, Madrid, Spain.

American illustrated medical dictionary. By W. A. NEWMAN DORLAND, A.M., M.D., F.A.C.S., member of the Committee on Nomenclature and Classification of Diseases, American Medical Association; Editor of "American Pocket Medical Dictionary"; with the collaboration of E. C. L. MILLER, M.D., Professor of Bacteriology and Biochemistry, Medical College of Virginia. *Fourteenth edition.* 1927: pp. 1388; 8¼ x 4¾ in.; 319 illustrations; flexible binding, plain $7.00, thumb index $7.50. W. B. Saunders Company, Philadelphia and London.

The contributions of the Eastern Association of Graduates of the Angle School of Orthodontia to Orthodontics. A review and index of its *Proceedings.* By BERNHARD WOLF WEINBERGER, D.D.S. 1927: pp. 48; 7½ x 4⅝ in.; no illustrations. Eastern Association of Graduates of the Angle School of Orthodontia.

Gangrene of the dental pulp and its treatment as based on a biochemical investigation. By GUSTAV HEDSTROM (translated by CARL WESTMAN). 1927: pp. 178; 6⅝ x 4 in.; 35 figures. Dentalaktiebolaget, Stockholm, Sweden.

Lectures [6] on the biologic aspects of colloid and physiologic chemistry. A series of lectures given at the Mayo Foundation and the Universities of Minnesota, Iowa, Washington (St. Louis), and the Des Moines Academy of Medicine, Iowa. By six investigators in the field. Introduction by Louis

B. Wilson, M.D., Director of the Mayo Foundation for Medical Education and Research. 1927: pp. 244; 6¼ x 3⅞ in.; 85 illustrations; $2.50. W. B. Saunders Company, Philadelphia and London.

Dental education in the United States and Canada. By WILLIAM J. GIES, M.S., Ph.D., Sc.D., LL.D., F.A.C.D., Professor of Biological Chemistry, Columbia University; Executive officer of the Board of Editors, *Journal of Dental Research;* with a preface by HENRY S. PRITCHETT, Ph.D., Sc.D., LL.D., Litt. D., President of the Carnegie Foundation for the Advancement of Teaching. 1926 (issued in 1927): pp. xxii + 692; 7¼ x 5 in.; one illustration; distributed free of charge on application, by letter or in person. Bulletin Number Nineteen, Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.

(*See reviews on pages 515–30 of this issue.*)

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